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Agriculture

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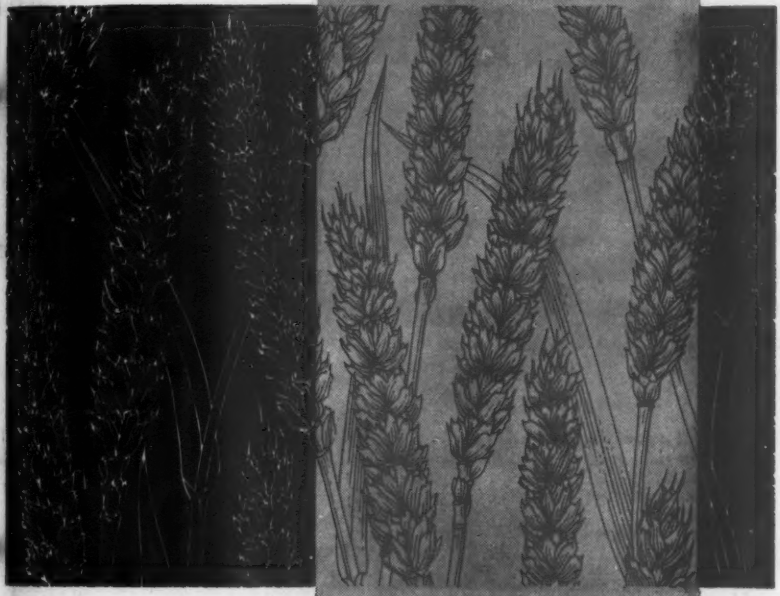

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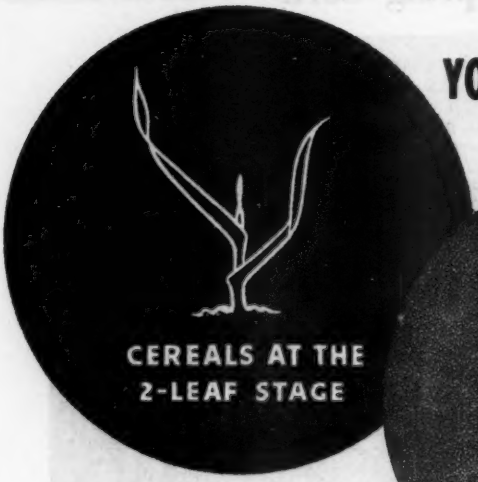

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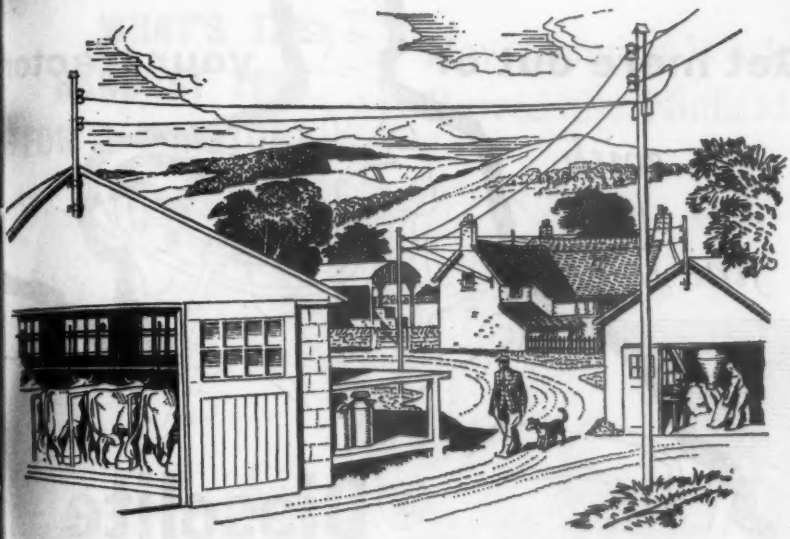

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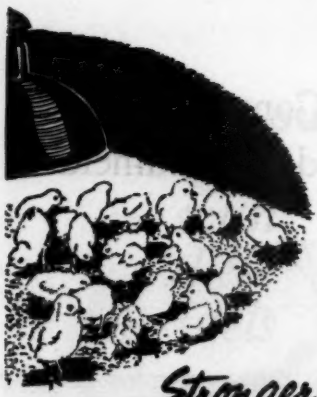

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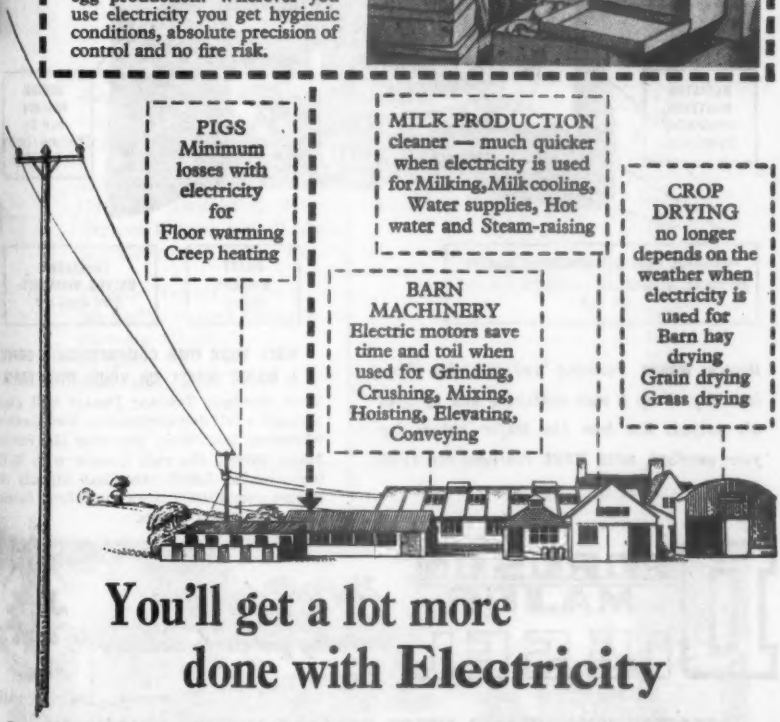

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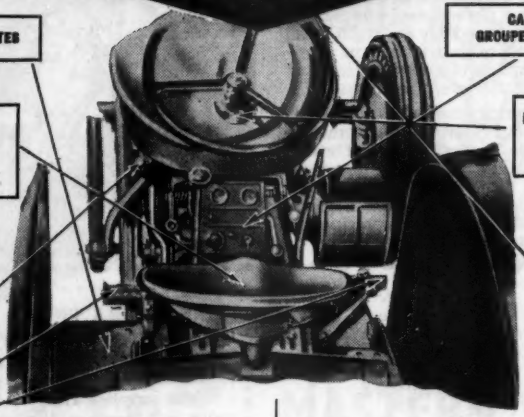
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Winter spraying of brambles

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AGRICULTURE

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BLOAT

What causes bloat? There are many theories, but in fact we still do not know. This article from the Agricultural Research Council surveys the present extent of our knowledge and points to the lines of research being pursued in this country and abroad.

DESPITE the suggestion that it is associated with modern farm practice, the problem of bloat is by no means new. It may occur in cattle, sheep or goats, but cattle, particularly dairy cattle, are the most prone to the condition, and it is world-wide. In 1951, it was estimated that veterinarians treated as many as 13,000 cases of cattle bloat in the state of Wisconsin in the U.S.A. alone. How many cases occurred which were not reported, where cattle died, or where the farmer dealt with them successfully himself, or where the animals recovered without the disorder being recognized, we can only guess. It is also difficult to assess how far bloat adversely influences grassland farming programmes, but there is little doubt that the fear of bloat has prompted farmers all over the world to reduce their use of valuable leguminous pastures.

Bloat has a number of well-recognized pseudonyms, including "blown" and "hoven", and many local names. Veterinarians use the term "tympanitis", referring to the drum-like condition of the abdomen. The symptoms associated with the condition are an accumulation of gases in the first stomach or rumen of the animal, causing it to "blow up". Large quantities of gas are normally produced by the fermentation of foodstuffs in the rumen and this, in a healthy animal, is got rid of by belching, but in bloat the gases are trapped in the paunch. Where the gas remains in the space above the stomach contents, the condition is referred to as simple bloat, but when the gases are mixed up with the contents it is called frothy bloat. A swelling in the left flank of the body between the last rib and the hip-bone is the first obvious sign of bloat; later the whole abdomen becomes very tense and drum-like. The afflicted animal stops eating, there is much saliva at the mouth, breathing becomes rapid, the eyes begin to bulge and the animal becomes increasingly restless, finally making frantic efforts to relieve the pressure of gas in the stomach. Unless the animal can gain relief, it may die in a very short time, even within a quarter of an hour of the onset, so it is not always possible to get a veterinarian to give treatment before it is too late. Such a quick sequence of events gives a farmer a feeling of complete impotence.

The Mystery of Bloat The precise cause (or causes) of bloat remains a mystery. A number of explanations have been suggested, but often they are no more than theories. There seems little doubt that bloat is usually connected with feeding fresh green material, and it is generally accepted that it is dangerous to turn out a herd on to rapidly growing pasture, especially if it is abundant in the succulent leguminous lucerne and clover. Being young and non-fibrous, the herbage is very soon broken down by the bacteria in the rumen and large quantities of gas are formed. Experimental evidence, however, does not support the conclusion that excessive gas production in the rumen is itself the cause of bloat. It has also been suggested that the fact that cows bloat in some years and not in others on the same legume pasture may be explained by the influence of rainfall, which, if heavy, may cause harmless pastures suddenly to become dangerous. Others believe that the lack of coarse roughage, which is necessary to start belching, is a contributory cause; but it has been found that coarse roughage in the rumen may in itself be insufficient to stimulate belching in an animal prone to bloat. The animal may not be able to get rid of the excess gas because of the closure of the gullet. It is well known that a potato or small turnip will cause such an obstruction, but simple cases of this kind are more properly termed "choke" and are usually easily remedied. Individual cases of bloat may also arise from a swelling of the lymph glands in the chest due to some disease, usually tuberculosis, in which these glands are affected.

Another suggestion which has been made is that bloat is caused by a rise in the level of liquid in the rumen to a point which blocks the opening to the gullet. According to this theory, the level of liquid is affected by the type of food: for example, grass and legumes sink to the bottom and, partly by displacement and partly by the production of gas and froth, raise the liquid level; work done in the U.S.A. by X-rays has, however, shown that this theory has no foundation. It has been suggested, too, that saponins in clover or potatoes may cause the frothy type of bloat, these substances, acting like soap, causing a foam in liquid so that the gas cannot escape. It would be interesting to know what percentage of bloat cases are of this kind.

About two years ago the N.A.A.S. and the Veterinary Service conducted a national survey on the incidence of bloat. The various study groups found that although bloat occurred mainly on lush, short-term leys, rich in clover, there were many instances of its occurrence on permanent grassland and clover-free pastures: it also occurred after feeding kale and sugar beet tops. The study groups also found that the incidence of bloat varied from season to season, being worst in spring, and that it had some relation to weather conditions. One group obtained some evidence indicating such a relationship between dew on herbage and the incidence of bloat, but there was not much support for this view from the other groups. Unfortunately, very little information has been gleaned from the survey as to the precise cause or causes of bloat and the study groups are inclined to the view that this will be revealed only through fundamental investigations in animal physiology.

Some investigators believe that bloat is due to the failure of the normal muscle movements of the rumen. Apart from those who would attribute such failure to the absence in the feed of roughage and other materials likely to start belching, there are others who consider that poisoning of the muscle results in paralysis. Many different substances, including hydrocyanic acid and toxic gases, might produce such poisoning in the rumen. It has also been suggested that bloat may be a manifestation of an allergic response in cattle in which there is a spasm of the muscles of the front part of the

stomach, not unlike asthma in man. But there is no doubt that a satisfactory theory of the cause of bloat must explain the fundamental condition as well as account for the sequence of symptoms; possibly several factors operate together.

There seems to be some justification for the view that tendency to bloat is inherited; and evidence from workers in Britain and New Zealand has gone some way to prove that heredity does in fact play a considerable part in this condition. As yet, however, there is no conclusive evidence about particular breeds being more susceptible than others.

The difficulties have been summed up by Sir James Scott Watson, who said recently: "The normal machinery of ruminant digestion is far from being fully understood, and hence it is not remarkable that the scientist cannot yet explain how or why it sometimes gets out of gear—as in the case of bloat."

Investigation in Britain and Abroad Investigations on bloat are in progress in Great Britain and abroad, but progress has been slow because, until recently, there has been no reliable means of producing bloat at will. Experimentation is also difficult because animals so often make spontaneous recovery from mild bloat. During the last few years the National Agricultural Advisory Service has focused increased attention on bloat, and bloat study groups, which have already been referred to, have been set up at all Provincial centres. Specially prepared grass and herbage plots have been laid down at the Grassland Research Station, Hurley, and at Ilsley, Compton. From the former we may find out the kind of herbage that is likely to produce bloat, and from the latter we shall be able to study grazing behaviour and test the effect of large quantities of grass and clover juices on bovines. The grasses in this cultivated pasture are: perennial ryegrass, cocksfoot, Kentish wild white clover, Danish meadow fescue, English broad red clover, timothy, Montgomery late-flowering red clover, and white clover S.100.

Cattle from Compton have been transferred to nearby farms where there are pastures which have a reputation for producing bloat, and the feeding behaviour of the animals has been carefully watched and recorded. Records have also been made of respiration and heart-beat rates before and during grazing and blood samples are sent to the Ministry of Agriculture's Veterinary Laboratory for analysis.

Other research has also been developed during the last few months at the Agricultural Research Council's Field Station, Compton. This work relies on the collaboration of the N.A.A.S., veterinarians and farmers within a wide radius of the Field Station. Arrangements have been made for cases of bloat to be reported by telephone, carcasses of dead animals will be collected, and veterinarians sent immediately to take blood samples of bloated animals that are still alive.

The Compton scientists are also following up the work done by Pest Control Ltd., Cambridge, where a substance was found which inhibits the action of the enzyme choline-esterase in blood, which is necessary for the proper action of the stomach's nervous system. This substance was isolated from white clover S.100, and it was suggested that its inhibitory action might have some relevance to bloat. A substance that can influence the action of the nervous system in this way should clearly be investigated further, and work recently begun at Compton on these lines includes a comparative study of the choline-esterase inhibitor level in bloated and normal cows. Blood and portions of the wall of the digestive tract of

normal and of bloated cows are being examined for the activity of this enzyme.

Cuttings have been taken from some bloat-provoking pastures and the juice has been expressed from them at the I.C.I. Research Station at Jealott's Hill. The juice has later been inoculated into the rumen of experimental animals at Compton and a condition resembling bloat has been produced.

The work at Jealott's Hill on this problem since the war has aimed at the isolation from clover of a substance which might be responsible for causing partial paralysis of the stomach muscles. It has already been demonstrated there that whereas juices of the most prevalent pasture grasses in Great Britain have little effect on the isolated rabbit intestine, those from certain legumes (for example, clover and lucerne) caused relaxation and partial paralysis. In view of the possible association between bloat and muscle activity of the rumen, it is thought that these findings may be of some significance. Recent work on the same lines at the University College, Aberystwyth, with the leaf juice of white clover, has indicated that another factor responsible for the effect on the rabbit intestine is hydrocyanic acid. In one experiment at Aberystwyth, a litre of clover juice (equivalent to about 5 lb. of fresh clover) was introduced directly into the rumen of a sheep and movements of the rumen were paralysed immediately.

Many people have wanted to know how the pressure inside the rumen increases as bloat develops, and an instrument has recently been designed at the Rowett Research Institute with which measurements can be made on the cow's flank of the pressure inside the rumen. This instrument has shown considerable promise but is not yet sufficiently accurate and modifications are being made to it.

Much of the work carried out in different states in the U.S.A. is co-ordinated with that being done in the Department of Agriculture's own research station at Beltsville. Among the many lines of study are: the effects of saponins and related substances, particularly those found in lucerne and clover; the mechanism of eructation, including a motion picture using X-rays to ascertain rumen motility; the mechanism of rumen movement by means of recording instruments attached to various areas of the rumen and the use of drugs to slow down or stimulate rumen movements; and the use of surface active agents, such as detergents, to cure bloat.

In New Zealand the problem of bloat is being tackled from two main centres. Work at one is concerned principally with red clover and lucerne as causes of bloat, and possible prevention of bloat by limiting intake. At the other centre an experimental unit has been set up to investigate the problem by using identical twin animals. Many interesting observations have already been recorded. One is that bloat may be prevented by feeding oils, such as linseed oil, turpentine, paraffin, peanut oil, etc.; a recent suggestion is to spray peanut oil on the pasture. These oils appear to break down the froth and release the gas. It is evident that a concerted effort is being made in tackling this old problem, but the investigatory work is still in its preliminary stages.

Suggestions for Preventing Bloat The following ways of preventing and dealing with bloat have been recommended from time to time. It will be seen that they amount largely to a question of management.

(a) Feeding hay or good straw before turning out. When cases of bloat appear in a herd, all animals should be moved temporarily to rougher pastures or provided with palatable hay. Laying straw on pasture may also help.

(b) Many believe it is not desirable to let cattle graze a sward which has a clover content of more than 50 per cent, as judged by eye, especially if the clover is S.100; and it may be better to cut this kind of sward and allow it to dry for 24 to 72 hours before being fed to cattle.

(c) The practice of controlling feeding by means of a portable electric fence has been recommended as a safeguard, but grazing should be carefully watched and the fence frequently moved, allowing only small bites at a time. The grazing of animals first turned out in spring should be restricted to short periods each day for a start.

After all this, the farmer may well ask what he can do in an emergency, if veterinary advice is not available. The extreme step, when a badly bloated animal shows no sign of recovering, is to puncture the animal high up on the left flank to let out the gas. A trocar and canula are preferable to a knife, because relief of pressure is more certain and the wound heals better. Wounds caused by such sticking should be kept clean. They are usually slow in healing and it is advisable to obtain veterinary attention. In less severe cases of bloat, if there is time it is best to get a veterinarian to relieve the gas pressure. In this connection it may be interesting to recall Leonard Mascall's words, in 1591: "Strike a hole with a knife or bodkin into the hollow part of his back above his flanke, and so thereat lets out the winde by a fether or quill, and so he will recover againe. But beware ye strike him not so deepe that ye pearse his guts."

The importance of bloat is well recognized and research on it will be continued and developed wherever opportunities occur. It is, however, one of those problems which it has not been possible to solve by the direct approach; in the end its solution may well depend on the "inspiration" of some research worker.

Some Articles of Outstanding Interest

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B. C. V. Oddie, B.Sc.

Assistant Director for Physical Research, Meteorological Office

The rain-making experiments carried out on Salisbury Plain last autumn have given rise to a good deal of misunderstanding in the public mind. The only expected effect of cloud-seeding is a slight increase in the natural rainfall over a small area. It is extremely unlikely that rain can be induced where it would not otherwise fall.

THE recent announcement that experiments on the artificial production of rain had started in this country elicited a wide variety of reactions; but the commonest was to ask why in so wet a country we should need more rain. The craft of rain-making, however, was born and developed in America, and in that country few were troubled by such doubts; for "the West"—which accounts for nearly half of the country—is an arid land where lack of water is the main obstacle to development. The power to increase rainfall even slightly would obviously be of incalculable value in such conditions.

The pioneers of rain-making were the General Electric Company, who assembled a brilliant research team at the end of the war to study the problem. Their starting point was the work of a Swedish meteorologist, Bergeron, on the formation of raindrops. That raindrops are formed from cloud is obvious. But a cloud is composed of minute droplets of water, so small that they can float in the air almost indefinitely. How are these particles gathered together to form a raindrop? Some quite powerful mechanism is evidently required, for an average raindrop is equivalent to about a million cloud particles.

At that time, Bergeron's opinion was that appreciable amounts of rain were possible only if the top of the cloud was at a temperature well below freezing point. One might suppose that as soon as the cloud reached a temperature of 32°F. all the little droplets of which it is composed would freeze, but in fact they do not do so at all readily. A natural cloud has usually to be cooled to something like 3°F. (or 29 degrees below freezing) before appreciable numbers of ice crystals appear. As soon as they *are* formed, however, these ice crystals begin to grow quite rapidly, at the expense of the still-liquid droplets near them. They can, in fact, grow large enough to yield a fair-sized raindrop within half an hour. There is a complete physical explanation of this growth, although it is too long to be given here.

Bergeron used this process to account for the formation of raindrops. Almost all raindrops, he suggested, begin as ice crystals, and although we now know that there are other ways in which rain can be formed, it is reasonably certain that it does often originate in this way. Now, this at once suggests a way of making rain, for we have already seen that ice crystals do not readily form in a cloud. Anything that helps them to do so should, it seems, increase the rainfall.

It was from this line of thought that the idea of rain-making developed. The obvious way of applying the principle is to fly above a suitable cloud and drop some very cold material into it. Pellets of "dry ice" (solid carbon dioxide) are normally used, and some very striking results can be obtained in this way. But an aircraft is expensive to operate, and it "seeds" only a

narrow strip of cloud above which it flies. It soon became evident that this method was not economically satisfactory. What was wanted was some way of seeding a much greater area of cloud without the use of aircraft.

The G.E.C. research team believed that they had found the answer in silver iodide. Even the minutest crystals of this material cause ice crystals to form when introduced into a super-cooled cloud, and it was found that silver iodide crystals could be produced in enormous numbers by means of very simple and inexpensive generators. All that was necessary, then, was to set up a few generators in a suitable place and leave the natural air movements to carry the crystals up into the cloud. Calculations suggested that the amounts of silver iodide needed would be quite small, and the whole operation is so cheap, and the area which can be treated so large, that even a small increase in rainfall would justify the outlay.

Can we make Rain? Against this, a number of formidable arguments can be raised. It is not certain or even very likely that, in general, particles released from the ground will find their way in considerable numbers to a height of 8,000 feet or more. Even more important is the question whether there is really much additional water to be got out of the cloud. A system of rain clouds is a water-producing organization. Air flows continuously into it from below and out at the top, leaving most of its moisture behind. Thus the cloud system has an income (the moist air) and an expenditure (the rainfall), and it has a certain amount of water in reserve, which forms the cloud which we see. The seeding technique does nothing to increase the income—it merely increases the expenditure by drawing on the reserves. Obviously, this can serve only for a short time, and afterwards expenditure will have to be reduced to enable the reserves to be built up again. In other words, if one area gets more rain by seeding, the next area over which the cloud passes may well get less. But the immediate point is that the reserves in the cloud are remarkably small, and it is far from evident that it is possible to get a significant increase by merely drawing off a part of the reserves.

Nevertheless, several American commercial rain-making firms have been operating for some years with this technique, and government services in many parts of the world have also been experimenting with it. The results of this considerable body of work have not been very sensational. They are perhaps best summed up in the words of an impartial committee of investigation appointed by the World Meteorological Organization. This body, speaking in 1954 of rain-making in general, said: "Operations which have been carried out so far have produced results which could be termed, at best, inconclusive. Present-day techniques . . . have very little value, if any, in augmenting precipitation in areas of very low rainfall or during dry periods."

It is, as a matter of fact, extremely difficult to know whether one has produced *any* effect by seeding from ground generators. It is useless to attack a cloud unless it is at least 5,000 feet thick and has a temperature well below freezing point at its top. But a cloud such as this will be very likely to give rain unaided: and, indeed, the claim made for rain-making is usually not that it will make rain when none would otherwise have fallen, but that it will *increase* the natural rainfall. This at once makes assessment difficult. What means have we of telling how much of the rain which has fallen on a particular occasion is natural and how much is artificial? The safest method is to compare the rainfall in the seeded area with that of a nearby unseeded area. But here we come up against the great natural variability of rainfall. The differences caused by seeding are certainly

considerably less than the natural differences between one locality and another. To disentangle the natural from the artificial variations is a job for statisticians, and it is generally accepted by them that several years of carefully controlled experiment will be needed to establish whether seeding does have any appreciable effect. Unfortunately, the essential elements—continuity and control—are lacking from a great part of the results available at present, many of which have been obtained in the course of commercial seeding operations.

Interest in rain-making has meanwhile been growing steadily, and even in Great Britain, where rain is relatively plentiful, the subject has been raised repeatedly in Parliament and the press. It was this wide public interest, in a subject where the facts are so uncertain, that led to the starting of the present series of trials on Salisbury Plain.

Salisbury Plain Experiments Since the object is to acquire knowledge of a technique, and not to control the climate, the experiments on Salisbury Plain are being conducted on a small scale. On the approach of a suitable cloud belt, five silver iodide generating stations are set up on a line about 23 miles long, lying roughly NNE-SSW—that is, at right angles to the prevailing wind. The generators are started an hour or two before the cloud belt comes overhead, and continue to operate until about two hours after it has passed. An average experiment lasts about ten hours, consumes about 6 lb. silver iodide, and costs about £100 in materials and overhead costs.

The generators are very simple. Each is made from a brazier's kerosene-burning blow-lamp, modified so that a solution of silver iodide in acetone can be fed into the flame at a controlled rate. They are kept and prepared for use at the Chemical Defence Experimental Establishment, Porton, where they were designed and tested. Each generator produces something like twenty million million silver iodide crystals per second. This is a very large number, but we do not yet know whether it will be sufficient.

The estimations of the results will be based on the rainfall recorded by the network of rain gauges which covers this country—probably the closest network of its kind in the world. For each occasion, the location of the seeded area will first be established by studying the winds at all heights up to the level where the silver iodide is expected to have taken effect. The rainfall in the seeded area will then be compared with that in nearby unseeded areas. There will usually be a difference, due partly to the natural variation of rainfall from place to place, and partly to the result of seeding, if any. By averaging over about 100 or 150 occasions, it is hoped to eliminate the natural variations and so to be left with the effect of seeding.

These trials will be carried out only when the winds are between south and west, and the silver iodide is unlikely to reach the necessary height before it has travelled about 50 miles. The seeded area will generally lie, therefore, in the East Midlands, Eastern Counties, or Home Counties. Only broad layer-type clouds will be seeded—mainly, it must be admitted, because this eases the statistical difficulties, but there is a secondary result that no experiments will be conducted in conditions likely to give hail, thunder, or very heavy rain.

The experiments did not begin until after the 1955 harvest, and so far there have been only three trials. It is therefore much too early to start assessing results. But it is difficult to see how the work can do any harm to agriculture. The materials are harmless and are released in very small amounts, and the only likely result is a small increase of rainfall at a time when there would have been rain in any case. Moreover, the area affected,

being determined mainly by wind direction, will vary from experiment to experiment.

There remains the question as to what would be the consequences if these, or any other experiments of a similar kind, were to show that rainfall can be controlled on a scale which is economically significant. One can hardly imagine such a power being left in the hands of commercial operators, and one may surmise that, sooner or later, a government would endeavour to use it for the general good. Some may feel that this is an alarming prospect, but at least there is no danger that any step taken would be irrevocable. If organized rain-making failed to satisfy the public, it would have only to be stopped and the ordinary course of nature would return.

HIGH AND LOW VOLUME SPRAYING COMPARED

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Effectiveness of the job to be done and the operational economies to be made are the principal factors deciding the choice between high and low volume spraying.

IT is almost ten years since the first really practical low-volume spraying machine was put to commercial use in this country. Since then there has been an enormous increase in the use of variants of this type of equipment in agriculture. More recently, experiments have resulted in the low-volume application of fruit sprays, but the subject is such a large one that this article has been confined to agricultural equipment.

Before the introduction of the first low-volume agricultural sprayer it had been usual to use machines applying a few pounds of active chemical—insecticide, fungicide or weed-killer—in solution or suspension in anything between 70 and 120 gallons (700 to 1,200 lb.) of water per acre. The first machine was designed to use 10 gallons (100 lb. only) of water per acre and apply 5 lb. of a fixed copper fungicide to potatoes for the control of Potato Blight. In this machine the concentrated spray suspension was pumped at very low pressure (5 lb. per sq. inch) to a series of large orifice nozzles. At the nozzle, large volumes of air supplied by a fan through an annular space atomized the spray and carried it on to and into the crop.

Experiments showed that, using only 10 gallons of water per acre, the control of Potato Blight was as effective as when applying the same amount of copper in 100 gallons or more per acre. Other uses were found for the machine and it was discovered that the plant growth-regulator types of weed-killer were just as effective as when applied with large quantities of water. Although this particular machine made a considerable saving in application costs by reducing the quantity of water used, it was fairly expensive. It was used by contractors but was beyond the pocket of the average farmer.

A Farmers' Machine In 1948 a much cheaper and simpler version of the conventional high-volume machine was designed which, because of its low cost, was of considerable interest to the farmer. Usually having a simple gear pump and pumping the spray at low pressure

(30-40 lb. per sq. inch) through nozzles fitted with small orifices, this machine has found a number of uses.

Since the commercial introduction of this type of machine in 1949, the number of agricultural low-volume sprayers in use in this country has risen from a few hundred to between thirty and thirty-five thousand. However, in spite of this enormous growth in the numbers of these machines and the wide acceptance of this method of spraying, it must be realized that low-volume application is not a universal panacea; high-volume spraying and sprayers are still very necessary. In fact, since the original 10 gallons per acre was decided upon, it has become desirable to use a wide range of application rates which, for ease of reference, are classified as:

Low volume—up to 30 gallons per acre
Medium volume—from 30 to 60 gallons per acre
High volume—above 60 gallons per acre

Because the prime requirement of a low-volume sprayer is its ability to pump liquid at low pressure through small orifice nozzles, it will be seen that almost any type of spraying machine can be used for the application of small quantities of spray and that the class to which a machine belongs is, therefore, largely controlled by the capacity of its pump.

Application rates are conventionally calculated assuming a tractor speed of 4 miles per hour. By considerably reducing speeds, it is possible to use almost any sprayer as a high-volume sprayer.

With their simpler pumps and smaller tanks, the low- or low/medium-volume sprayers are particularly attractive to the farmer because of their lower initial cost. Prices today vary considerably, but there is a very large number of different makes of machines at prices between £50 and about £100. The difference in cost is accounted for by the fact that, for £50, the machine is capable only of low-volume application rates, whereas the more expensive ones, at about £100, are also medium-volume sprayers. Prices of high-volume or universal sprayers vary widely and, although there are machines capable of high-volume application rates costing about £150, most universal models cost well over £200.

In calculating the life of a sprayer, obsolescence and deterioration in storage are probably more important factors than reasonable wear and tear in use. Depreciation is arrived at more satisfactorily by writing the machine off over a given number of years than by assessing it on the number of acres sprayed. It is, therefore, a fixed annual charge which usually constitutes quite a large percentage of the total application costs per acre. The exact amount, of course, depends on the number of acres the farmer has to spray, and he must consider this in conjunction with the cost of the machine he is proposing to buy.

Scope for Saving Time and Money Purchase by the farmer of a low-volume machine costing about £60 can be justified on financial grounds with an acreage to be sprayed as low as 30 and, under some circumstances, this acreage may be even lower. If, on the other hand, high-volume spraying is necessary, then the acreage that has to be sprayed each year to justify the purchase of a machine costing £250 is anywhere between 80 and 100 acres, again depending upon local contractors' charges. After depreciation, labour and tractor operating costs are the most expensive items, and between them these three items represent about 90 per cent of the total costs of application. The more time that can be spent in actual spraying as against time "wasted" preparing the chemical and filling up with water, the cheaper will be the overall cost of the operation per acre.

HIGH AND LOW VOLUME SPRAYING COMPARED

The biggest single factor contributing to a reduction in lost time is a reduction in the quantity of water needed to spray each acre. A high-volume machine is provided with a much larger tank than its low-volume counterpart, and this does to some extent offset the saving. Without doubt, however, for any given size of sprayer tank, there is a considerable saving in spraying costs the lower the application rate per acre. It has been shown that, even with low-volume sprayers, 50 per cent of the time is often spent refilling the tank. The following calculations demonstrate the importance of reducing the quantities of water used per acre:

Using a universal sprayer with 100-gallon tank, 40 acres can be sprayed in an 8-hour day at an application rate of 10 gallons per acre.

1. Assume a spraying speed of 4 m.p.h.; an application rate of 10 gallons per acre; and a 20 ft. boom.

	min.
Total spraying time for 40 acres	250
Preparation, travelling to field, etc.	60
Balance: refilling time and miscellaneous stoppages	170
Total time for 40 acres	480
	=8 hours

Sprayer refilled 4 times. Average refilling time, etc.

$$\frac{170}{4}=42 \text{ min. approx.}$$

Actual spraying time per acre $=\frac{250}{40}=6.25$ min.

2. Assume a spraying speed and boom as above but an application rate of 50 gallons per acre.

	min.
Spraying time per tank load for 2 acres	12.5
Refilling time and miscellaneous stoppages	42.0
Total time for 2 acres	54.5

Number of acres per 8-hour day, allowing for preparation but assuming no blocked H/V jets

$$2\left(\frac{480-30}{54.5}\right)=16.5 \text{ acres approx.}$$

While this does not mean that the cost of application at 50 gallons per acre is 2½ times that at 10 gallons per acre, it does mean a considerable saving in labour and tractor costs with a lower application rate.

The Machine for the Job The simple low-volume machine fitted with a gear pump can spray solutions and emulsions without damaging the equipment; it is also possible, under certain circumstances, to spray some types of suspension. Growth-regulator type weed-killers, particularly when used in cereals and on grassland, are an obvious choice for this type of equipment at application rates of 10-20 gallons per acre. With insecticides, application rates are usually 20 gallons of spray per acre, and DDT, formulated either as a miscible liquid or an emulsion, can be used for the control of Flea beetle in brassica crops, Beet and Mangold fly, Carrot fly, Pea and Bean weevil and Pea aphid. Seed crops can be sprayed for the control of Clover Seed weevil and Pollen and Mustard beetles. It is also possible to apply a spray for the destruction of potato haulm, but at a minimum application rate of 25 gallons of water per acre.

The possibility of applying blight sprays with this type of low-volume machine depends upon the type of product used. Bordeaux and Burgundy mixtures are quite unsuitable; they cannot be concentrated to the degree necessary for low-volume application. Fixed copper fungicides can be used,

provided care is taken not to exceed the recommended concentrations and that the material is such as not to damage the pump. By complying with these conditions, the application of 5 lb. of fungicide, containing 50 per cent of copper, in not less than 20 gallons of water per acre will give prolongation of plant growth equal to that obtained by using the same quantity of fungicide but applying it with 100-120 gallons of water per acre. The first application must be made before the disease appears and before the potato haulms close across the drills.

Pros and Cons The high-volume or universal machine will, of course, apply any of these products. In addition, it will handle others which, either because of their physical properties or mode of action, or because of the type of plant or habits of the insect, cannot be sprayed with a simple low-volume machine. It is absolutely essential to realize the limitations of the low- and the low/medium-volume sprayers and not to try to use them for purposes for which they were never designed. The application of some chemical formulations requires a very efficient agitation system. The relatively small capacity of the pump fitted to a low- and low/medium-volume sprayer means that, with the higher volume applications, practically the whole of the output of the pump has to be directed to the nozzles, with the result that there is very little surplus available for return to the tank to keep the spray chemical properly suspended. If, therefore, agitation is to be maintained by spray recirculated into the tank, it is essential to have a large capacity pump which can return at least 50 per cent of its output to the tank. Alternatively, an efficient mechanical agitator is essential. The di-nitro weed-killers, such as DNC and dinoseb, are materials which, to give consistent and reliable results, should be applied at rates of at least 60 gallons per acre and which, at the same time, require an efficient agitation system. They should not, therefore, be applied with anything other than a proper high-volume machine.

High volume spraying undoubtedly gives more efficient control of certain insect pests such as Pea moth, Pea thrips, aphids and caterpillar on brassicas. This is particularly true when spraying contact insecticides. There is less risk of drift with a high-volume machine, for there is a much lower percentage of smaller spray droplets. There is also less risk of phytotoxic damage to the crop because the material is not applied in such concentrated form and any over-spraying is compensated by "run-off". It is also true that there is greater safety for the operator applying toxic compounds at lower concentrations. Finally, with the larger sized nozzle, there is less risk of blockage by foreign matter.

There is no doubt that there will continue to be a use for high-volume spraying machines until such time as other chemicals are available which do not necessitate their application in large volumes of water. When such are available they should, preferably, be formulated as solutions, miscible liquids or emulsions not requiring considerable agitation.

Next month Dr. Holmes will deal with horticultural spraying equipment.

BRACKEN ERADICATION ON THE CLWYDIAN RANGE

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The scheme which the sheep graziers on the steep-sided Clwydian Range started in 1954 is an outstanding example of how the bracken menace on hill grazings can be beaten back by a concerted, all-out attack.

THE Clwydian Range of hills forms the eastern flank of the Vale of Clwyd in Denbighshire and Flintshire, North Wales. The southern end stretches for about 6½ miles, roughly from the town of Denbigh to Ruthin, and covers something like 2,500 acres. From the boundary of the enclosed land of the farms at about 600-700 feet, it rises to over 1,850 feet at the summit. It is extremely steep in parts and is subdivided into numerous sections by mountain streams and dingles. Over the past half-century the ever-present bracken has gradually extended its grip on the area; in the memory of living men it has spread up the hill at a rate of about 15-20 yards a year, until it now covers practically the whole of the better grazings. Farmers who have known this area all their lives have estimated that during the past fifty years about 1,000 acres of bent-fescue pastures in the middle of the Range have succumbed to bracken domination. The result has been not only a severe deterioration in the quality of the pasture, and less stock in consequence, but also a considerable increase in the work of shepherding on the hill. For the sheep, dissatisfied with their own grazing, have tended to wander in search of food. Tall bracken also provides ideal hiding places for maggoting sheep and makes it difficult for even the keen-eyed shepherd to spot them.

The area is a manorial common and most of the twenty-odd farms adjacent have their "cynhefin", or grazing, upon it. Those who are acquainted with mountain sheep will know that each flock instinctively recognizes its own particular grazing area, and even though there is no hedge or fence to distinguish the boundary, the sheep invariably keep to their own area.

Two years or so ago a group of farmers who had common grazing rights on the Clwydian Range met to consider the possibilities of a co-operative scheme to control the bracken which was destroying their grazings. The problem had been exercising the minds of some of them for many years, and this meeting had been called by Capt. B. E. Rowley Williams of Glyn Arthur and Capt. F. A. Frost of Fron Ganol—two graziers who between them owned a large proportion of the sheep on the hill. The result of that meeting was that the graziers formed themselves into a co-operative society whose main aim was to control this serious bracken infestation. Members of the National Agricultural Advisory Service attended this first meeting and have since been involved in the proceedings in an advisory capacity. The Denbighshire A.E.C. was asked to undertake the work on behalf of the Society, and an application was made to the Ministry of Agriculture for a grant under the Bracken Eradication Scheme. The new association was also given every assistance and administrative help by the Welsh Agricultural Organization Society.

In due course, the scheme which had been submitted to the Ministry was approved and a 50 per cent grant was promised towards the cost. At the

onset, it was agreed that charges on the graziers should be made by way of an annual headage levy of the ewe flocks, and for 1954 this was fixed at 2*s.* 6*d.* per ewe—a fee which was subsequently renewed for 1955. Since the sheep population on the Range approaches 2,000, this meant that the Society could look to an annual income of £500, made up by £250 contributed on a headage basis by the graziers and a pound-for-pound grant by the Ministry.

Initial Difficulties But how was the job to be tackled? The Denbighshire A.E.C. had a small three-gang bracken breaker, and this was first tried behind a wheeled tractor on a 4-acre block. But this was not very satisfactory, and the work was extremely slow and very costly—£20 for this one small block. A larger machine was therefore devised for use behind a crawler tractor, and this certainly enabled the work to go on much faster and cheaper. Even so, it was not completely satisfactory, and eventually the makers of a heavy crushing machine (which it was thought would be more suited to the conditions) were consulted. In consequence, a new seven-gang machine, crushing a 17-foot swath behind a crawler tractor, was obtained.

It was originally envisaged that about 350 acres would be treated, but this new machine, together with some extremely skilful handling by the tractor driver, enabled the target acreage to be considerably exceeded. By the end of the season some 500 acres had been crushed once, and 90-100 acres dealt with a second time. The scattered and irregular pattern of the areas crushed, together with the fact that the land had not been surveyed on the Ordnance Survey map, made it impossible to be exact about the total area treated, but the information gleaned by an accurate survey undertaken in 1955 points to the figures quoted as being a pretty close estimate.

Due to the late start and the very great difficulties experienced at the outset, it was found impossible to crush the whole area twice during this first season. It is generally agreed by all who have had experience of this work that double crushing is very desirable, but to have done it in the first season would have resulted in much of the land getting its second crushing much too late to derive real benefit. It was therefore decided to reserve any unspent money for the following year. As things turned out, this was a very wise precaution, because, due to increased prices and extension of the area treated, the £500 allocated for the second year proved quite inadequate.

Seven Hundred Acres in 1955 The spring was very late in 1955, and at the time when one would normally expect the bracken to be at the stage for the first crushing it was hardly out of the ground. Work was therefore started some three weeks later than had been originally expected. When growth conditions became normal, however, the tendency was for everything to spring ahead, and when the crushing eventually got under way the machines could hardly go fast enough to cover the ground at the proper time. As might be anticipated, the heavy going and the rough ground also resulted in considerable losses of working time due to mechanical breakdowns. In spite of these difficulties, however, some 684 acres were crushed before the end of the first week in July.

The manufacturers of the crushing machine took a very keen interest in this scheme right from the time they were consulted, and with their co-operation two machines were provided in 1955—the original seven-gang breaker being supported by a nine-gang breaker cutting a 22-foot swath. The two machines were worked together, crushing between them a strip approximately 39 feet wide. The same tractor driver, now well versed in his task as the result of his experience in the previous year, was in charge of

the operations during this second season, and he was accompanied by an equally keen, efficient, and venturesome driver on the other machine. To these two men, more than to any other one person, is due the credit for this work. Watching these machines climbing up and down the steep, bracken-covered slopes, some of them with a gradient of more than 1 in 3, the observer could not fail to be impressed by this example of British workmanship and skill at its best.

After the middle of July, when the first cutting had been completed, the machines were taken off the hill and thoroughly overhauled. At the beginning of August work was restarted at the point that had been dealt with at the beginning of the first cutting. The whole area was completely gone over for the second time, and work was finally completed in mid-September.

The Grass Returns It is too soon yet to say what the results of the crushings will be, but it was obvious that the growth of bracken last year was very much less dense than that of the year before. To quote an example, one small area cut in mid-August 1954 yielded 4 tons of air-dried material per acre. The regrowth was crushed at the end of August and was then left untreated and examined at the beginning of September 1955. The bracken growth on it was very much less dense than in the previous year and reached a maximum height of 2½ feet in September, compared with 4½ feet the previous August. There was also quite an appreciable growth of grass (mainly bent-fescue) at the base.

This regrowth of grass was also noticeable in many areas over the whole Range. By next summer the effect will probably be even more marked. The process has been assisted in a small area of some 4 acres by the application of fertilizer over the whole and the distribution of grass seed cleanings across half of it. This work was in the nature of an observation plot and did not enter into the graziers' scheme.

It must be borne in mind, of course, that the whole of the credit for the recovery of the grass cannot honestly be given to the bracken eradication scheme. The disappearance of the rabbit has also contributed a good deal.

Seven Shillings an Acre During the first season the A.E.C. contract charge for crawler and crushing machine was 26*s.* per hour, and at this rate the total cost for both cuttings was £428 12*s.* Some 600 acres were crushed (510 acres in the first round and 90 acres in the second) in 330 hours of actual working by the A.E.C. machine, at a gross cost of 14*s.* 4*d.* per acre. Taking into consideration the 50 per cent grant, the Society therefore had to pay 7*s.* 2*d.* an acre for the cutting in the first year. It was also able to get the work done within the income for the year.

By the beginning of this second season, the contract charges had risen to 30*s.* per hour, due to an increase in the hourly tractor rate. The total area crushed was 1,368 acres (684 acres crushed twice), done in 633 working hours. It will be remembered that there were two machines working for most of the time, and this figure represents the total time worked by both machines. The final cost was £952 10*s.*, which works out at a shade under 14*s.* per acre per crushing. The cost to the graziers was therefore just under 7*s.* an acre.

The amount of money available in 1955 on the headage basis was insufficient and it was necessary to make an additional levy of 2*s.* 6*d.* per ewe for the season. Assuming that the costs next year will be about the same, the gross cost for the whole work for the three years will be about 4 guineas an acre, of which the occupiers will have paid half. For this

2 guineas the bracken will have been crushed twice for three successive years. However, it is anticipated that, benefiting from the experience gained during the first two seasons and assuming that the land can be covered much more quickly next season due to reduced growth, this figure is the maximum.

Better Sheep from the Hills This, briefly, is the story of an unusual enterprise by a progressive group of farmers. It is to be hoped that similar ventures will be undertaken elsewhere. If they are, there is no doubt that their organizers will benefit considerably from the lessons learned on the Clwydian Range. There are hundreds of thousands of acres in the country which could be similarly tackled, and vast areas could be done more easily than this.

Mention has already been made of the extremely steep slopes of parts of the area treated, and the skill of the tractor drivers cannot be stressed too strongly. The graziers, at a recent meeting, expressed their very great appreciation of the work done by these two men, as well as of the assistance they have received from the makers of the machines. It can be truly said that this was a pioneer scheme, and all involved have learned a good deal from it. But this apart, what are the immediate benefits to be reaped by the members of the Society? The main result is that the Range will be able to carry more sheep; but far more important is the fact that it will also be able to produce *better* sheep. For quality rather than quantity is the aim of these farmers.

MOBILE GLASSHOUSES

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Mobile glasshouses are slightly more costly to install than static glass, but the additional expense is amply repaid by more intensive production, better soil conditions, and the saving on sterilization. Mr. Smith sees their principal value when the crop rotation regularly includes tomatoes.

THERE is a new interest in mobile glasshouses. This seems to have been stimulated by the system, which I believe had its origin in Holland, of building a house on rails, designed to run over small wheels borne on emplaced "dollies", instead of attaching the wheels to the house itself. The rails add strength and rigidity to the structure, and less material is required. Individual dollies also offer much less obstruction to the cultivation of uncovered sites than do low walls or concrete wheel tracks. But before I go on to discuss the pros and cons of the mobile glasshouse, perhaps it would be as well to define the term "mobility". Briefly, a mobile house is one which can be moved quickly and easily from one site to the next without distorting the structure or damaging the crops. There should be the minimum of preparation before the move and of adjustment afterwards. Normally, the mobile glasshouse should be moved five or six times a year, depending, of course, on the sequence of crops to be grown.

What are the advantages of a mobile glasshouse? The most important feature is that it permits a system of rotational cropping to be practised which delays or may prevent the development of soil pests and diseases. Good soil conditions are easier to maintain by the weathering of uncovered sites during the winter months. Mobility also ensures the fuller use of glass coverage throughout the year, in so far as preparation for one crop in the sequence may proceed on the open ground while another crop is still covered. In many instances, the crops to be covered successively can be partly grown on the uncovered sites and the glass moved over them at the appropriate time. Thus the mobile house is seldom empty or marking time while cultivations are being carried out and planting done.

But mobile glasshouses also have their limitations. The first drawback is that a level or near level site is essential, and this will need to be from three to five times the area of the mobile house, so as to provide for the necessary number of moves. The next is that a large area of ground has to be covered with concrete dollies, which offer serious obstruction to mechanical cultivations. This difficulty can be met in part by designing houses with the widest possible roof span, but there is also scope for new developments in mechanical cultivators to work neatly in restricted areas. The rotary cultivator is of value but does not meet every requirement.

Another possible objection to mobiles is their higher initial cost, compared with equal areas of static glass. It can be shown, however, that the additional capital outlay is well invested. This extra expenditure need not be excessive. It has to cover the cost of rails, wheels, and dollies for the requisite number of alternative sites. A few, but very few, extra structural members are required for bracing the house, and another length of heating main will be needed if the house is to be heated. A good winch is essential, but one can be made to serve the needs of many mobile units. The rent for the additional land required will generally be negligible, and there is no reason to believe that depreciation on a mobile glasshouse need be greater than on a static structure of similar design.

The returns from the investment come in a number of forms. There will be a saving on the costs of soil sterilization, whether done normally by steam or by chemicals, and on the handling of crops, such as bulbs and chrysanthemums, which may be planted *in situ* and covered, rather than grown in pots or boxes which must be carted in and out of a static house. A higher return should also be obtained from the better crops made possible by better soil conditions, and from the more intensive use of the glass cover—a factor which may amount to 10 per cent or more in the course of twelve months.

Principles of Construction Details of the design of mobile glasshouses are outside the scope of this article, but the broad principles may be considered in so far as they affect the crops which are to be grown. The construction must be light in weight to facilitate movement. It must also be light in the sense that it permits plenty of sunlight to the plants to be grown inside it. The widest possible roof span must be used. A narrow roof span entails the use of far too many dollies, with the consequent obstruction to mechanical cultivation already mentioned. It should also be borne in mind that the dollies, plus the bearings and wheels which go with them, are fairly expensive pieces of equipment. By doubling the width of the roof span, it follows that we reduce the number of dollies by half.

Dutch lights may still be used for cheapness. It was thought at one time that the loose glazing of the Dutch light was necessary to avoid glass breakage as the result of possible distortion on the mobile house during movement. There is now ample evidence that permanently glazed structures

can be moved without breaking the glass. There is no grave objection to the Dutch light, provided it is used on a 20-foot roof span, or in a modified form on a 15-foot span. But perhaps there is little logic in using portable glazing units on a structure which is itself mobile! Manufacturers are already turning their attention to the production of permanently glazed houses, and a number of growers have built such houses for their own use.

The ends of the mobile house should open, so that it can be moved over standing crops. Incidentally, this arrangement also offers a very convenient means of giving a crop full ventilation when it is required.

A mobile glasshouse should be designed to suit the crops it is intended to grow. There seem to be no limitations on height or width of span in the mobile house which are not also inherent to the static house. Yet despite the absence of narrow limits (at least one mobile house in Holland covers an acre and is moved by three winches from one side of a drain to the other), there is much to be said in favour of smaller units. They are certainly easier to move, although if they are heated there is, of course, a proportional increase in heat losses through the glass as they get smaller. The main factors influencing the size of individual mobile units on any particular holding should, however, be the type of crops to be grown and the total production of the holding.

Planned Cropping With mobiles, it is very important to adopt the principle of housing one crop at a time, and to extend it to the point of ensuring that the harvesting of the covered crop will take place over the shortest possible period. If, for example, a mobile house is to be used for forcing bulbs, it is important that it should cover only those varieties which can be brought into flower together. If this would entail a crop too big to be handled by the staff in the time available, then the answer is to have smaller units and not to extend the flowering period of the crop in each unit.

As soon as a crop is harvested, a mobile house should be ready to move on to the next. If harvesting in part of the house lags behind that in another part, the fullest use cannot be made of the glass coverage, and, what is more serious, a large part of the house may have to be heated to no useful purpose.

The heating of a mobile glasshouse seems to present no serious problem. The thermosyphon system, high-speed hot water, and low-pressure steam have all been used. The alternatives are either to extend the heating main so that it reaches all the sites of a mobile house, or to have a mobile boiler which moves with the house. The first method seems to be the more popular, although the possibility of using mobile hot-air units has not yet been fully explored.

The value of unheated mobiles must not be overlooked. It is, in fact, in unheated mobiles that the main interest has developed in the East Riding of Yorkshire. This is not unexpected, since the unheated mobile is a logical development of the system of Dutch light cultivation which has been practised in the area over the last quarter of a century. In the spring Dutch lights are used to bring forward a series of crops, and the lights are finally moved on to a structure for a summer crop of tomatoes. The mobile glasshouse can be used in a precisely similar way, but with all the advantages of a glasshouse, where work can go on in most kinds of weather, as compared with frames, which are limited to fair weather cultivation.

Crops which are particularly suited to mobile glasshouses fall into two broad categories. Firstly, those which gain a particular benefit from rota-

tional cropping; and, secondly, crops like chrysanthemums and bulb flowers which normally spend part of their life in the open and part under cover.

The number of alternative sites to be provided for each mobile unit depends on the cropping sequence to be followed and the needs of particular crops. It is inadvisable to have less than three sites; possibly five is somewhere near the ideal, even if one of them has to go down to an occasional short-term ley, the benefits from which have not yet been assessed in connection with glasshouse crops.

Benefits of Crop Rotation In making an assessment of the future of mobile glasshouses in Britain, we must look at one or two of the broader aspects of glasshouse production. The statistics for England and Wales show that each year some 80 per cent of the total area of glass is cropped with tomatoes, so that at the very best a glasshouse can be rested from tomatoes only once in five years. But it is safe to say that the majority of tomato houses grow a crop every year without a rest, a system which is made possible only by resorting to such expensive practices as the partial sterilization of the soil by steam or chemicals. Ideally, the tomato would enjoy a system of crop rotation which allowed it to be grown on the same soil not more than once in five years, or perhaps once in seven years in Potato Root eelworm districts. To achieve this end with permanent houses, the acreage of glass would have to be increased by four to six times, or the acreage of tomatoes reduced correspondingly. In neither case is there an alternative crop to fill the houses resting from tomatoes. To advocate a system of crop rotation for tomatoes without the help of a mobile glasshouse is therefore wishful thinking.

How far can we be satisfied with partial soil sterilization as an alternative to rotational cropping? Apart from the high cost of this treatment, it must certainly bear some responsibility for poor quality fruit. How far does it also impair soil structure? "The first crop of tomatoes is always the best," is a common saying amongst growers. In other words, in the soil of a permanent house there is a factor which is lost after the first tomato crop. If by the use of mobiles it can be shown that this factor can remain unimpaired over a substantial proportion of the life of the house, then, with the ever-increasing fuel and labour costs involved in tomato production, the case for the mobile glasshouse would be complete.

There are, of course, an infinite number of crop rotations which may be practised without tomatoes, but in the end it will be the influence of mobiles on tomato production which will establish them as a permanent feature of glasshouse production in this country.

Owing to the printing trades' dispute, it is regretted that the production of this issue has been unavoidably delayed.

CHEMICAL STERILIZATION OF SOIL IN GLASSHOUSES

F. W. WEBB, N.D.H.

The Murphy Chemical Co., Ltd.

Chemical sterilization will not entirely replace the usual heat treatment of glasshouse soils; but it is a much cheaper process and, used as a partial substitute for steaming, will do much to cut costs. Mr. Webb here discusses the chemical sterilizers available and their particular uses.

IT is well known that the practice of covering land with a permanent glasshouse structure has the effect of producing a soil status quite different to that found under field or garden conditions. This is brought about in at least three ways. First, by maintaining an artificial climate suitable to the requirements of crops grown under glass, changes occur in the balance of the population of micro-organisms in the soil, the result of which is made apparent in reduced fertility. Secondly, the practice of mono-cultivation over a period of years allows diseases and pests to build up—for example, Potato Root eelworm following continuous cropping with tomatoes. Finally, the high rate of applying mineral salts, such as sulphate of potash and superphosphate, together with the exclusion of the leaching effects of heavy rainfall, results in a high salt content (expressed as *p*C value). This condition may markedly inhibit the growth of plants but cannot be corrected by soil sterilization.

For many years sterilizing the soil, either by means of heat or chemicals, has been accepted by commercial growers as a necessity if remunerative crops are to be grown. It is true to say that in the old-established areas of commercial glasshouse production, such as the Lea Valley, the degree of freedom from eelworm and soil-borne diseases (such as *Verticillium* sp.) is due solely to the recognition of the need for soil sterilization every year.

The application of heat, whether by baking, steaming, or, as practised more recently, by the direct or indirect use of electricity, is generally regarded as being highly effective in achieving the desired objective. Of these alternatives, steam is the most flexible and efficient for conveying heat from its source into intimate contact with soil particles. The recent work carried out at Silsoe, Fairfield and Bayfordbury in the use of pressure-reducing appliances has changed the practice of steaming from a blunderbuss task into a precise operation. But in spite of this, steaming is still very costly when considered in terms of man-hours.

In the Lea Valley and other areas where industry competes on very advantageous terms with horticulture, labour is now both scarce and expensive, and the grower is always on the look-out for methods of sterilizing his soil which will be almost as effective as steaming but less costly in labour. It is here that the use of chemicals should be considered.

Chemicals are applied to the soil either by mixing them with the water normally given for winter flooding, or by means of a soil injector. Either of these methods is much cheaper than steaming, as far as labour is concerned.

Unfortunately, there is no one chemical which will do everything that steaming will do, and the time will inevitably come in most nurseries when, in spite of the use of chemicals over a number of years, steaming will have to be carried out. However, the use of chemicals as an alternative to steaming—for example, every other year, or two years in three—is worth thinking about. If chemicals are used in nurseries where a steam boiler is part of

the equipment, it will be necessary to steam only one-third of the soil annually. In other nurseries a contractor need only be called in every third or fourth year.

Choice of Chemical Cost alone is not the criterion which should influence a grower in the choice of a chemical sterilizer. The prime considerations should be: what is the main need for sterilizing, and what causal organisms are to be eliminated? These may be "soil sickness", due to an unbalanced status of micro-organisms in the soil; soil-borne fungi, such as Phytophthora or Verticillium; nematode infestation, such as Root-knot eelworm, or Potato Root eelworm; or other animal organisms, such as woodlice, symphylids, spring-tails, etc. A combination of any of the above will often be found to be the reason for reduced crop yields.

The modern chemicals in common use, together with their respective suitability for dealing with the main causes of crop reduction, are as follows:

FORMALDEHYDE. In nurseries where losses are attributed to "soil sickness", and also where there is evidence of fungus diseases such as "foot rot", "damping-off", "buck-eye rot", wilt, etc., formaldehyde is a suitable material to use. It is not so effective against eelworms and other animal organisms.

Formaldehyde is a gas which is soluble in water to the extent of 40 per cent: commercial formaldehyde is usually about a 38 per cent solution. Care should be taken to obtain it in a fresh condition, since it is subject, during prolonged storage, to a chemical change known as polymerization. This may result in the formation of a white gelatinous mass which reduces the strength to some extent and makes the material difficult to use. In some cases, a cloudy or milky appearance may develop after cold weather, but this is of no importance. Non-polymerizable formulations are available. The normal concentration is 1 gallon of 40 per cent formaldehyde in 49 gallons water, applied at the rate of 5 gallons to a square yard. Some growers have used formaldehyde at 1½ gallons to 39 gallons water and have claimed much better results. The successful use of any chemical which is carried in water will depend upon the degree to which penetration to each soil particle is achieved. No hard and fast directions can be laid down, since soil types vary so much, but the following remarks may be helpful.

Dust-dry soils are very difficult to wet, and a certain amount of pre-watering will allow the formaldehyde to penetrate better. Dry, lumpy clay soil should be pre-watered and well cultivated to reduce the soil lumps to the smallest possible size. It is often helpful to put on only half the recommended volume of solution in the first instance. Then, when this has soaked well in, the soil should be turned over and the remainder of the solution applied. There are a number of well-designed, automatic diluting appliances available which can be used for applying both sterilizing liquids and liquid fertilizers. Some of these appliances are fitted with a meter by which the quantity given per square yard can be measured accurately.

The vapour of formaldehyde is highly poisonous to plant life, so a period of 4-6 weeks, depending upon temperature and type of soil, is usually necessary before it is safe to take plants into a treated glasshouse. In any case, a few test plants should be put in the glasshouse for a couple of days or so before any general planting or transfer of plants is made.

CRESYLIC AND TAR ACIDS. Where there are no problems with fungus disease organisms, and animal pests and "soil sickness" are the main concern, a cresylic-type sterilizer can be used. This material is, however, not very effective against eelworm. Most of the sterilizers of this type are available

under proprietary brands, either bearing the name of emulsified cresylic acid or a particular trade name. The rate of use for a 40 per cent tar acid material is 1 gallon in 99 gallons water, applied at the rate of 7 gallons per square yard. Unlike formaldehyde solution, which penetrates the soil at constant strength, tar acid sterilizers tend to lose strength as they penetrate. This is due to the tar acid being adsorbed on to the soil particles near the surface. There is thus a greater need to apply this type of material in two operations, turning the soil over in between.

The vapour given off from tar acids is not as destructive to plants as that from formaldehyde, so the interval between applying the liquid and planting is consequently less. But care should be taken during spells of hot sunshine, when a high concentration of vapour may occur.

D-D (a liquid product consisting of a mixture of isomeric dichloropropenes together with 1, 2-dichloropropane and other chlorinated hydrocarbons). With Root-knot eelworm (*Meloidogyne* spp.) D-D will give a substantial measure of control. With Potato Root eelworm (*Heterodera rostochiensis*), D-D will give sufficient control to enable the plant to grow away strongly in the early stages and produce a crop, but by the end of the season there will be a considerable reinfestation and treatment with D-D will be necessary every year. D-D is poisonous and must be handled with care. Every precaution should be taken to avoid breathing the vapour and to prevent the liquid from coming into contact with the skin, particularly the eyes and nose. The method of application is by injector, at the rate of 300-400 lb. per acre on soils of medium texture. On heavy land and on soils of high humus content, or where there is a high water table, the recommended rate is 200 lb. per acre. After applying D-D, the soil should receive a *light* watering and be left undisturbed for at least three weeks. It should then be well cultivated to facilitate the release of D-D vapour. It is of the greatest importance that all the vapour should be released before planting takes place, and soil aeration is the only way in which this can be done.

When it is required to control soil diseases as well as eelworms, it is suggested that the soil should be forked over three weeks after D-D has been applied, and the heat turned on for 48 hours. Flooding the soil with formaldehyde solution may then be carried out.

D-D is corrosive to many metals, so the injector and other equipment used should be thoroughly washed with paraffin after use.

CHLOROPICRIN (TRICHLORNITROMETHANE). This material is tear gas, which should be sufficient to indicate the hazard associated with its use. It is quite definitely not a material for the grower to apply, and should only be handled by experienced operators employed by a contractor.

Chloropicrin was first used in this country by Mrs. Matthews working at Cheshunt in 1919, when it was found to give a good control of eelworm and generally to improve the condition of the crop. The material is applied by an injector at intervals of about 10 inches, and 1.40 c.c. is injected to a depth of 5 inches. After the injection the soil should be watered to a depth of one inch to seal the vapour into the soil. Four days after application, the soil should be cultivated. Planting can usually be done ten days later.

Chloropicrin is the nearest approach to steam sterilization as regards the universal nature of its effects. Some warning should be given, however, regarding damage which may occur to plants growing in nearby glasshouses during and after application. The vapour of chloropicrin has been known to "creep" underneath the partition walls from treated houses into adjacent houses, with serious results to growing plants. Damage has also been experienced from vapour drifting downwind to plants in other glasshouses.

ETHYLENE DIBROMIDE. This material is now being made available by at least one contractor. It is claimed to be effective for the control of eelworms, wireworms and the larvae of other insects inhabiting the soil. The use of ethylene dibromide may be compared with that of cresylic and tar acids, and the method of application is the same as that described for chloropicrin, including the need for a properly tested gas-mask.

PARATHION. Parathion has been found to be an extremely useful adjunct to the use of steam or chemicals. In many nurseries where there is a fair amount of old brickwork and large concrete dollies underneath the purlin posts, steaming and the use of various chemicals does not completely control Root-knot eelworm and symphylids. Twenty per cent parathion at 1½ pints per 100 gallons water should be applied at the rate of 1 gallon per square yard immediately after planting tomatoes. This early treatment is important, as eelworm infestation can take place within 48 hours of planting. Where only symphylid damage is experienced, the concentration of parathion may be reduced to ½ pint of the 20 per cent material per 100 gallons of water. Application can be made at the first ball watering, when ½-1 pint of the solution per plant is applied in place of the usual watering.

Parathion should be handled with extreme care; all the regulations laid down regarding protective clothing, etc., in the Agriculture (Poisonous Substances) Act 1952* must be scrupulously observed.

Cost of Sterilization It is not easy to quote a firm price for steaming. Much will depend upon variable factors, such as nature of soil, depth of cultivation, organization of labour, cost of fuel, cost of labour, whether the grower owns or hires the boiler and equipment, and whether the work is done on contract. An average price today would be in the region of £500-£550 per acre.

The cost of chemical sterilization may also vary considerably according to the particular chemical chosen. The cost of materials alone for treating an acre are as follows:

Material	Quantity per acre	Purchase	Cost per acre
	gal.		£ *s.*
Formaldehyde	480	12×40 gal. drums @ £9 15*s.* 10*d.*	117 10
Tar Acids Emulsified Cresylic Acid	339	8½×40 gal. drums @ £10 14*s.*	90 19
	194	5×40 gal. drums @ £14 4*s.*	71 0
	lb.		
D-D	360	6×60 lb. containers @ £7	42 0
	gal.		
Parathion (20 per cent)	9	@ £7 5*s.* per gal.	65 5

As already mentioned, application of chloropicrin should only be carried out by skilled operators and is best done by a contractor. The price for this is about £340 per acre. Ethylene dibromide can also be applied by contract service, at a rate of £95 per acre for 1-5 acres.

* Copies are obtainable from any Government bookshop, price 6*d.* (7½*d.* by post).

EXMOOR FARMER

W. D. BEARD, N.D.A.

National Agricultural Advisory Service, South-Western Province

A pen picture of a family farm of 500 acres in the picturesque but difficult farming country of Exmoor.

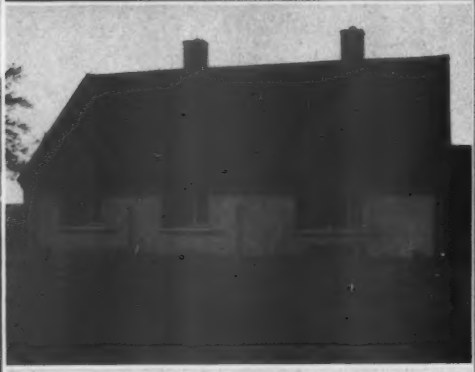
FARMING on the fringes of Exmoor, whilst presenting many attractions to the casual summer visitor, has many drawbacks, most of which are climatic and therefore cannot be remedied. To quote a few examples, the rainfall is high, averaging 56 inches, the winters can be both long and severe, and the steep nature and small size of fields often make the simplest work a major task. It is interesting to note that the area of Exmoor known as the Chains, where much of the rainwater which contributed to the Lynmouth disaster collected, is close to the farm described in this article.

Besides the natural hazards already mentioned, there are many man-made difficulties. Not the least of these is the maintenance of the banks and hedges used traditionally to make field boundaries and shelter for stock. The banks themselves are about 4 feet high, faced with turf or stone and topped by a hedge of beech or ash, and the work of keeping both bank and hedge in good repair is highly skilled and very laborious. Rabbits were once the chief culprits in the destruction of banks, and the coming of myxomatosis was generally hailed with delight by hill farmers. Many of the small fields on hill farms are now being thrown together by bulldozing out dividing fences so as to make the working of fields with mechanized equipment a little easier.

A man who has adapted his system of farming, and indeed his whole life, to suit these particular conditions is Mr. Jack Westcott of Hill Farm, Exford. Mr. Westcott, a tall, tough, upstanding man, has farmed at Hill for the last fourteen years. Before this he was at Picked Stones, a more remote moorland farm, from which he moved to be nearer to a school for his family.

As on so many hill farms today, it is the family that is the all-important unit, for with hired labour almost unobtainable, the running of the holding is shared by all its members. Mr. Westcott and his two sons deal with all the field work and attend to the stock. His wife and daughter keep the large farmhouse in spotless condition, look after the poultry, and cope with the many jobs that crop up in the yards and buildings. Although nominally retired, and living in a bungalow across the valley or "combe", Mr. Westcott, Senior, who originally had the farm, is still a force to be reckoned with, and lends a hand whenever required.

Hill Farm The holding generally known as Hill Farm actually comprises four farms of different sizes, all farmed as one block of some 500 acres. Most of the land is steeply undulating, and deep combes cut the block into rather inconvenient areas. In altitude, the farm ranges from about 900 feet above sea level at its lowest point to about 1,400 feet where the enclosed land joins the open moor. Until recently the only means of access was either by way of a steep, winding, deeply rutted lane which was impassable to motor transport, or by a long trek across fields which was practicable only in dry weather. Fertilizers and other bulky stores had to be left at outlying buildings for collection by horse or tractor.



Mr. Westcott (*standing*) with one of his sons.
Some of the Exmoor Horn ewes.
Devon cows with calves at foot.

The farmhouse at Hill Farm.
Cottage built under the Livestock Rearing Act.
Lambs on a ley at 1,300 feet.

Photo : *Ford Motor Co. Ltd.*

Steep slopes, often with a gradient of more than one in three.

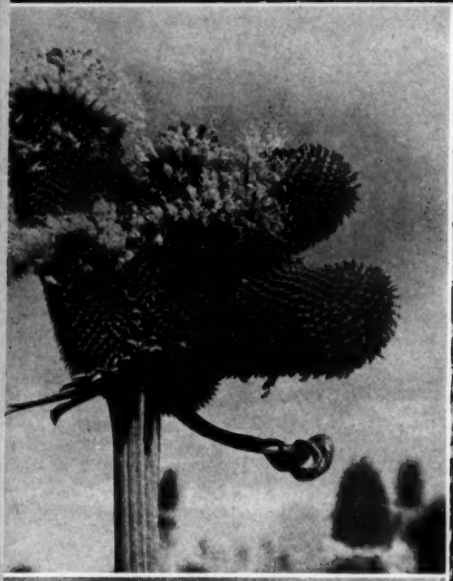
Photo : *Bertram Unne*

An aerial view of work in progress.

In 1954 a seven-gang machine was used behind a crawler tractor to crush a 17-foot swath.

Photos : *Cyril Lindley*

A close-up of the first crushing.



The main farmstead is typical of many in the Exmoor area. A long, low farmhouse with a slate roof forms one side of a rough square; buildings for stock, implements and fodder make the other sides, leaving an uneven, sloping yard in the centre. The whole group is built into the side of a hill, so that there is some protection from the prevailing wind.

The soil is mainly of a sandy nature overlying shale, and is generally rather shallow; indeed, in several of the fields the constant washing by heavy rains, combined with cultivation, has resulted in outcrops of shale. As the land nears the moor, the soil becomes more peaty, and the highest fields are quite black with boggy patches.

Although, by hill country standards, the farm is well watered, there is no mains supply, so full use has to be made of the streams and springs. Under such conditions it is obviously almost impossible to have a water supply in every field, and considerable ingenuity in the planning of the grazing is required to overcome this difficulty.

Grass and Crops The climate and other conditions rule out intensive arable farming, and, in common with most farms in the area, the main income is derived from the sale of store cattle and sheep. From this it follows that grass is by far the most important crop at Hill Farm, the actual division of the farms' acreage being: permanent pasture 230, leys 93, arable 33 and rough grazing 144.

The establishment of good pastures is naturally of great importance, and where the land is ploughable the following rotation is practised:

First Year—Roots. These are mainly common turnips which are folded off with the sheep, but small acreages of kale, cattle cabbage and potatoes are also grown.

Second Year—Corn. Invariably, the crop consists of Black Tartar oats which are fed in the sheaf to cattle in the winter, as the hiring of labour and threshing tackle is not an economic proposition.

Third Year. Reseeding with a cover crop of rape to a long ley, usually of the Cockle Park type. The young ley is folded off with the sheep and is thereafter grazed and mown alternately. The normal life of a ley is 5-7 years, but as soon as it shows signs of "going back" it is ploughed up.

Although acreages vary slightly each year, about 15 acres are reseeded annually in the manner described, with similar acreages in corn and roots.

As on so many upland farms, the soil at Hill Farm is short of lime and phosphate, so that fairly liberal dressings of ground limestone and basic slag are a normal practice. Two tons ground limestone and 10-15 cwt. basic slag per acre, once in the rotation, are the usual amounts for the ploughable land; the permanent pastures receive similar quantities every fifth year or so. In addition, dung and compound fertilizer are given to the root ground.

One of the Exmoor farmers' greatest fears is a long, hard winter, such as we had in 1947. In that year, when so many sheep and cattle perished on Exmoor, Mr. Westcott lost only two ewes. Although he modestly attributes this to "luck", one has only to visit the farm to appreciate the foresight that is used in the planning, harvesting, and storing of winter fodder.

Each year in June, July, or even later, depending on weather conditions, about 30 acres, mostly ley, are mown for hay. Although the pick-up baler is becoming popular in the area, Mr. Westcott prefers to rick his hay in the traditional manner and bale it from the rick after it has had time to mature.

Taunton Teasels
(Article on pp. 540-2)

Photo: *John L. Jones*

In his opinion, the double handling is amply repaid by the quality of the finished product.

When, as in the summer of 1954, almost incessant rain makes haymaking impossible, clamp silage is made and is readily eaten by cattle and sheep. Owing to the scattered nature of the farm, winter fodder is stored at various points, for, as many hill farmers have found to their cost, there is no sense in having one central store of food inaccessible to isolated groups of cattle in bad weather.

The small corn acreage, which is harvested late and often with great difficulty, and the fact that oat sheaves are fed whole to cattle, mean that no straw is available for bedding or thatching, but these difficulties are overcome by making use of bracken and rushes, both of which grow prolifically in the rough grazings.

Store Cattle and Sheep So far, only a passing reference has been made to the livestock, which are, after all, the main source of the Hill Farm income. True to the traditions of the district, Mr. Westcott breeds and sells as stores Devon cattle and Exmoor Horn sheep. The cattle, all of which are attested, consist of fourteen breeding cows, twelve heifers to be used for breeding, twelve yearling steers, and sixteen younger cattle and calves. All are home-bred and reared on the "one-cow-one-calf" system. It is Mr. Westcott's boast that since he started farming he has bought only one cow.

The cows and older cattle are not kept in during the winter, but live on some of the steep old pastures, or "cleeves", which are not damaged by heavy treading. Shelter is provided by some of the nineteen miles of banks and hedges on the farm, or by the open cattle sheds or "linhayes". These, however, are rarely used. Hay, whole oat sheaves and a few roots form their main diet. Younger cattle are given more shelter but appear to thrive on the same type of food.

Each autumn about a dozen eighteen-months-old steers are sold, together with such heifers as are not required for herd replacements, and any old or barren cows. In recent years the demand for attested beef cattle has resulted in ever-increasing entries for the autumn store sales at Cutcombe and Exford, which were at one time quite small local affairs but are now attended by buyers from far afield.

Hill Farm is also noted for the production of strong, healthy store lambs and excellent clips of wool. This year, for instance, fleeces from the flock won a prize in a wool competition at Yeovil. The sheep flock comprises 260 breeding ewes mated to locally bred Exmoor Horn rams, nine of which are kept. Every year about 120 ewe lambs are brought into the flock to replace the annual draft of ewes, which, together with the wether lambs and any surplus ewe lambs, are sold as stores in the autumn at local sales.

The work of tending the sheep and cattle is shared by Mr. Westcott and his two sons, one of whom has achieved considerable local distinction with his sheep-dogs. A sturdy pony is in constant use for the shepherding work and saves many miles of walking over rough country. Such ponies, together with the highly trained sheep-dogs found in the district, are, of course, virtually essential to the shepherd. Shearing the flock, no light task, is done on a "help your neighbour basis", the gangs of workers moving from farm to farm in turn.

On the more domestic side, the poultry, although not a major enterprise, provide a useful source of income. About a hundred laying hens are kept, replacements being reared each year from purchased day-old chicks. The

older birds are kept on free range and the pullets in deep-litter houses improvised in the farm buildings. This department, as might be expected, is capably managed by Mrs. Westcott and her daughter.

Farm Improvement No article on an Exmoor farm would be complete without mention of the assistance received by the farmer under the Hill Farming and Livestock Rearing Acts. Mr. Westcott is enthusiastic about the help he has received, and maintains that without it much of the excellent work carried out would have been impossible. Although the scheme approved for Hill farm was not elaborate, no essentials were omitted. The following are some of the items that have been carried out: improvement of main access road, provision of a cottage, piped water supply and store shed on off-lying land, installation of hot water system, bathroom, provision of an extra bedroom in the farmhouse, and minor improvements to the buildings. On the land, besides the normal work, 60 acres have been reseeded, 14 acres of pasture have been limed and 40 acres slagged.

Although one cannot imagine a farming family like the Westcotts having much spare time, it is not really surprising to find that these very active people take a keen interest in local affairs. The sons and daughter are prominent members of the Exmoor Young Farmers' Club, of which Mr. Westcott is Club Leader. Each year the Club holds a Field Day at Hill Farm, involving stock judging, thatching, and cookery competitions, to name but a few of the items. The organization of this event is no mean feat, and great credit is again due to Mr. and Mrs. Westcott for the smooth way in which a complex programme is carried out. Needless to say, Mrs. Westcott takes in her stride the provision of food and general hospitality inseparable from such an occasion. There is no doubt that the spirit of farm first, and personal pleasure a long way second, has made the Westcotts what they are—a united, happy and extremely competent Exmoor family.

National Diploma in Agricultural Engineering

The Institution of British Agricultural Engineers is offering at least two scholarships for award to candidates who are eligible for entry to the course of study leading to the 1957 Final Examination for the National Diploma in Agricultural Engineering. The Temple Press Scholarship, to the value of £100, is offered for the fifth consecutive year; the Dunlop Rubber Company Ltd. are repeating their offer of £250 for award primarily as a scholarship for the benefit of a degree holder who wishes to obtain the N.D.Agr.E. as a post-graduate specialist qualification. Full details may be obtained from the Secretary of the Institution, 6 Buckingham Gate, London, S.W.1. The closing date for completed applications is May 1, 1956.

The Final Examination in 1956 will be held at the Essex Institute of Agriculture, Writtle, Chelmsford, on July 24-27, inclusive, the oral examinations following on July 30-31. Entry forms are obtainable from the Secretary of the Institution. The closing date for applications is April 1, 1956.

WINTERING STORE CATTLE

COCKLE PARK TRIAL, 1954-55

PROFESSOR H. C. PAWSON, M.B.E., M.Sc., F.R.S.E.
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The eighth successive, and concluding, trial in a series of experiments to compare various systems of winter store management was conducted at Cockle Park during the winter of 1954-55.

ALL the previous reports* on the winter store management trials at Cockle Park have related to pure-bred young beef Shorthorn stores, but for this last winter several of the animals used in the trial were sired by an Aberdeen-Angus bull. The management systems compared were the same as in 1953-54—namely, outwintering as opposed to inwintering; a comparison of seeds hay with lucerne hay; and a comparison of grass silage with lucerne silage when fed to housed beef stores.

Roughages, all of which were grown at Cockle Park, were analysed at six-weekly intervals by the N.A.A.S. Nutrition Chemist for the Northern Province. Mean results are given below:

	Dry Matter	Crude Fibre	Crude Protein	Digestible Crude Protein	Estimated Starch Equivalent
	per cent	*percentage of dry matter*			
Grass silage	19.8	35.7	13.1	7.6	38.2
Lucerne silage	22.5	32.2	19.0	13.1	44.0
Seeds hay	86.4	38.5	5.9	3.0	30.6
Lucerne hay	85.9	33.8	11.1	7.8	33.5
Swedes	10.8	—	1.2	1.0	64.0

Perennial ryegrass and S.100 white clover predominated in the grass silage. This silage was well conserved but, owing to the fibrous nature of the original material, was classified as being only of moderate feeding value. Lucerne herbage was cut at the pre-flowering stage of growth and ensiled without any carbohydrate additive. The resultant product, though slightly overheated, was of useful feeding value and, in contrast to the legume silage fed in the preceding trial (1953-54), was highly palatable.

Tripods were again used in the making of the lucerne hay, and the conserved material was of good colour and excellent palatability. By contrast, the seeds hay underwent considerable weathering, with consequent detrimental results on its nutritive value and palatability, during the adverse haymaking conditions that prevailed in 1954.

Although the swedes were lower than average in dry matter, they were reported as being of satisfactory feeding quality.

After weaning at the end of October, the stores were allowed a preliminary fourteen days in which to become accustomed to the experimental conditions. At the end of this period the inwintered bullocks were taking an

* Reports of the Cockle Park trials have been published in the following issues of this JOURNAL:

November 1948, pp. 334-8.
January 1950, pp. 475-9.
January 1951, pp. 469-73.
December 1951, pp. 413-7.
December 1952, pp. 428-35.
June 1954, pp. 134-8.
March 1955, pp. 599-604.

Table 1

BULLOCKS

Wintered Outside v. Wintered Inside, 1954-55

LOT 1 8 Bullocks (Outwintered)	Ear Mark	Initial Weight Nov. 12	Weight Gain or Loss Dec. 10	Weight Gain or Loss Jan. 7	Weight Gain or Loss Feb. 4	Weight Gain or Loss Mar. 4	Weight Gain or Loss April 1	Final Weight April 1	Total Weight Increase
		cwt. qr. lb.	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*cwt. qr. lb.*	*lb.*
RATION PER HEAD PER DAY	9	4 3 10	14	8	12	16	20	5 1 24	70
	*16	4 2 24	18	18	30	14	12	5 2 4	92
lb.	5	4 2 0	10	8	16	6	18	5 0 2	58
Seeds hay 12.2	13	4 0 20	20	8	12	–2	18	4 2 20	56
Oats 1.5	*4	4 0 16	24	12	24	16	28	5 0 8	104
Beans 1.5	7	4 0 0	14	14	10	–12	40	4 2 10	66
	29	3 0 0	16	6	18	0	22	4 1 6	62
	32	3 0 22	18	–2	4	20	0	3 2 6	40
MEAN		4 0 18	16.75	9.0	15.75	7.25	19.75	4 3 3	68.5
LOT 2 8 Bullocks (Inwintered)	*3	5 0 20	20	34	36	36	44	6 2 22	170
	15	4 2 24	10	30	28	48	36	6 0 8	152
RATION PER HEAD PER DAY	36	4 1 12	8	24	16	22	24	5 0 22	94
	37	4 0 18	8	16	20	16	28	4 3 22	88
lb.	*24	4 0 6	24	26	36	38	36	5 1 26	160
Seeds hay 13.0	27	3 3 18	10	30	22	8	22	4 2 26	92
Roots 10.0	0	3 2 20	36	24	26	0	34	4 3 0	120
Oats 1.5	31	3 1 0	4	16	12	24	24	3 3 24	80
Beans 1.5									
MEAN		4 0 18	15.0	25.0	24.5	24	31	5 0 26	119.5
DIFFERENCE BETWEEN MEANS OF LOTS 2 and 1		0	–1.75	16.0	8.75	16.75	11.25	1 23	51

* Aberdeen-Angus cross-bred cattle.

average of 10 lb. hay per day, compared with a consumption of 7 lb. by the outwintered cattle. It should be appreciated, however, that the latter animals were on pasture which had a fair amount of autumn keep at the beginning of November. As the trial progressed the quantity and quality of grass available deteriorated rapidly and over the twenty weeks of the experiment the average daily hay consumption of the outwintered bullocks was only 0.8 lb. less than that of the inwintered cattle. The average daily food intake of the respective lots was:

	Seeds Hay	Lucerne Hay	Swedes	Oats	Beans
	lb.	*lb.*	*lb.*	*lb.*	*lb.*
Lot 1. 8 bullocks outwintered	12.2	—	—	1.5	1.5
Lot 2. 8 bullocks inwintered	13.0	—	10	1.5	1.5
Lot 3. 8 bullocks inwintered	—	13.0	10	2	1

These rations supplied the following quantities of nutrients per day:

	Lot 1 (Outwintered)	Lot 2 (Inwintered)	Lot 3 (Inwintered)
	lb.	*lb.*	*lb.*
Dry matter	13.14	14.91	14.85
Digestible crude protein	0.68	0.71	1.19
Crude fibre	4.28	4.55	4.01
Starch equivalent	4.87	5.76	6.0

Outwintered versus Inwintered The liveweight changes shown by the bullocks are given in Table 1 on page 535. As in all the previous reports, the inwintered steers made the greater increase, having an average gain of 119.5 lb., compared with 68.5 lb. by the outwintered animals. A study of the weight increases made by the inwintered bullocks over the last eight years reveals the lower than average gains made in the 1954-55 trial. This result reflects directly on the poor quality of the seeds hay.

Average Increase in Weight of Bullocks during the Winter Feeding Trials, 1947-54

	1947–48	1948–49	1949–50	1950–51	1951–52	1952–53	1953–54	1954–55	Mean
	lb.	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*
Outwintered ...	56	113	52	62	142	94	52	69	80
Inwintered ...	141	201	141	182	170	154	170	120	160
Difference ...	85	88	89	120	28	60	118	51	80

Seeds Hay versus Lucerne Hay A modified form of the trial instituted the previous year to compare the respective merits of seeds hay and lucerne hay was repeated, using two lots of eight bullocks. Both groups were housed under the same roof and all aspects of management, other than the rations fed, were identical.

Throughout the trial the daily hay consumption of both lots was maintained at the same level—a level determined by the intake of the less palatable seeds hay. Each group also received 10 lb. fingered swedes per day. In view of the superior protein content of the lucerne hay, it was felt that the 3 lb. concentrates fed to the Lot 3 animals should be in the proportion of 2 oats : 1 beans, instead of being the equal mixture of cereal and legume fed to the animals in Lot 2.

Table 2 shows that the bullocks fed on legume hay (Lot 3) were, on average, 30 lb. per head heavier at the end of the trial than those fed on

Table 2

BULLOCKS

Seeds Hay v. Lucerne Hay, 1954-55

LOT 2 8 Bullocks (Inwintered)		Ear Mark	Initial Weight Nov. 12			Weight Gain or Loss Dec. 10	Weight Gain or Loss Jan. 7	Weight Gain or Loss Feb. 4	Weight Gain or Loss Mar. 4	Weight Gain or Loss April 1	Final Weight April 1			Total Weight Increase
			cwt.	*qr.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*cwt.*	*qr.*	*lb.*	*lb.*
RATION PER HEAD PER DAY		*3	5	0	20	20	34	36	36	44	6	2	22	170
		15	4	2	24	10	30	28	48	36	6	0	8	152
	lb.	36	4	1	12	8	24	16	22	24	5	0	22	94
Seeds hay	13.0	37	4	0	18	8	16	20	16	28	4	3	22	88
Roots	10.0	*24	4	0	6	24	26	36	38	36	5	1	26	160
Oats	1.5	27	3	3	18	10	30	22	8	22	4	2	26	92
Beans	1.5	0	3	2	20	36	24	26	0	34	4	3	0	120
		31	3	1	0	4	16	12	24	24	3	3	24	80
MEAN			4	0	18	15.0	25.0	24.5	24	31	5	0	26	119.5
LOT 3 **8 Bullocks** **(Inwintered)** RATION PER HEAD PER DAY		23	5	0	4	10	26	30	22	48	6	1	0	136
		*2	4	3	14	20	24	42	46	34	6	1	12	166
		*1	4	2	0	30	24	44	42	44	6	0	16	184
		28	4	0	24	16	42	28	30	40	5	2	12	156
	lb.	12	3	3	20	14	26	42	20	44	5	0	26	146
Lucerne hay	13.0	18	3	3	8	22	34	36	28	38	5	0	26	158
Roots	10.0	34	3	1	20	14	32	26	34	30	4	2	16	136
Oats	2.0	33	3	1	18	0	46	36	8	30	4	1	26	120
Beans	1.0													
MEAN			4	0	17	15.75	31.75	35.5	28.75	38.5	5	1	27	150.25
DIFFERENCE BETWEEN MEANS OF LOTS 2 and 3					–1	.75	6.75	11.0	4.75	7.5		1	1	30.75

* Aberdeen-Angus cross-bred cattle.

seeds hay (Lot 2). This increase in live weight was not unexpected, as the bullocks on lucerne hay had a higher daily nutritive intake.

Each of the three lots of bullocks consisted of six pure-bred beef Shorthorns and two Aberdeen-Angus × Shorthorn cattle. A study of individual liveweight gains reveals that in all cases the cross-bred cattle were superior to the Shorthorns, thus illustrating the value of the Aberdeen-Angus sire in giving an early maturing tendency.

Comparison of Liveweight Gains

	Lot 1	Lot 2	Lot 3
	lb.	*lb.*	*lb.*
Mean for the Lot	68.5	119.5	150.3
Mean for Shorthorns	58.7	104.3	142.0
Mean for Aberdeen-Angus cross	98.0	165.0	175.0

Grass Silage versus Lucerne Silage Two lots, each containing five heifers, were fed on silage made from aftermath grass and lucerne respectively. The conduct of the trial differed from the previous year's experiment in that the two lots were maintained on the same silages for the whole of the twenty weeks, instead of reversing the diets every six weeks. It was felt that the six-week feeding periods were too short to permit a satisfactory working of the crossover design used in 1953-54.

Liveweight changes shown by the heifers (Lots 4 and 5) are given in Table 3. Contrary to the previous season's results, the lucerne-fed heifers made the greater liveweight gains and were, on an average, 44 lb. heavier after the twenty weeks. A comparison of the analysis of the food supplied reveals that, while the daily silage consumption was very similar in the two groups, the superior feeding value of the legume resulted in the Lot 5 animals having a considerably higher nutritive intake.

The average daily quantities of nutrients supplied by the respective rations were:

	Lot 4 (Grass Silage)	Lot 5 (Lucerne Silage)
	lb.	*lb.*
Fresh silage consumed	67.4	67.9
Dry matter	13.34	15.28
Digestible crude protein	1.01	2.00
Starch equivalent	5.09	6.72
Crude fibre	4.76	4.92

From the results of the corresponding trial the year before it was concluded that the differences in liveweight increase were apparently due to the superior palatability of the grass silage as compared with that of the lucerne, and not to any difference in their nutritive value. This year, the palatability being similar for both silages, it is concluded that the variation obtained in liveweight increase may be due to the difference in nutritive value.

Conclusions For the eighth successive year beef stores inwintered on a ration of hay, roots and concentrates made greater liveweight gains to similar animals outwintered on hay and concentrates. Lucerne hay and silage were found to give greater liveweight increase than seeds hay and grass silage—a superiority attributed to the higher nutritive intake provided by the legume.

The writers wish to acknowledge the valuable assistance given by Mr. P. P. Brennan, B.Sc., Farm Manager, and Mr. K. Wright, Assistant Stockman, in the conduct of the trial.

Table 3

HEIFERS

Grass Silage v. Lucerne Silage, 1954-55

LOT 4 5 Heifers (Inwintered)	Ear Mark	Initial Weight Nov. 12			Weight Gain or Loss Dec. 10	Weight Gain or Loss Jan. 7	Weight Gain or Loss Feb. 4	Weight Gain or Loss Mar. 4	Weight Gain or Loss April 1	Final Weight April 1			Total Weight Increase
		cwt.	*qr.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*cwt.*	*qr.*	*lb.*	*lb.*
Ration: Grass silage to appetite	*14	4	3	16	–24	6	28	18	32	5	1	20	60
	*17	3	3	12	10	2	16	16	28	4	2	0	72
	8	4	0	0	–18	16	18	14	28	4	2	2	58
	20	3	2	24	2	16	14	14	12	4	0	26	58
	21	3	2	4	–4	12	16	18	20	4	0	10	62
MEAN		4	0	0	–6.8	10.4	18.4	16.0	24	4	2	6	62
LOT 5 5 Heifers (Inwintered) Ration: Lucerne silage to appetite	10	4	2	20	–8	0	28	34	36	5	1	26	90
	*11	4	2	0	–4	–2	32	30	40	5	1	12	96
	22	3	2	20	–6	8	30	38	38	4	2	16	108
	*19	3	2	10	8	12	36	24	40	4	2	18	120
	26	3	2	6	6	6	34	28	38	4	2	10	116
MEAN		4	0	0	–0.8	5.6	32	30.8	38.4	4	3	22	106
DIFFERENCE BETWEEN MEANS OF LOTS 4 and 5		–	–	–	6	–4.8	13.6	14.8	14.4		1	16	44

* Aberdeen-Angus cross-bred cattle.

TAUNTON TEASELS

JOHN L. JONES

Teasels are a little known crop, whose cultivation is now confined to a few farms in Somerset. The humble, spiny flower-heads have an irreplaceable value on the wool carding machines of Yorkshire for raising a nap on the cloth.

MENTION teasels to a West countryman and he will probably tell you that a few are still grown "somewhere around Taunton". This is only roughly correct, for the boundaries of the teasel *locale* have an unusual precision. It is in fact a closely restricted area—about six miles across, with the little villages of Curry Rivel, North Curry and Fivehead as the population centres of the farming districts concerned. Within these close limits the last English teasels are now cultivated as a farm crop, involving about fifty growers and with an annual area fluctuating between 250 and 300 acres.

The teasel is grown as a crop for its prickly flower-heads, which consist of hundreds of small pliable spines or awns curving outwards at the extremities to form "hooks". Their use is in the cloth finishing factories for "teasing" or combing up the nap or pile on fine quality face cloths: hence the older, traditional name of "fuller's teasel". In the factory, the teasel heads are mounted on rods which are inserted into a rotary cylinder called a teasel-gig. The cloth to be teaselled, of the same width as the rods, is wound around several layers, and as the machine is set in motion, the roll of cloth counter-rotating against the teasels is brushed gently by the supple spines of the teasel heads, which pluck up a fine, uniform nap on the woollen surface. The unique superiority of the teasel lies in its use on the really fine worsteds, for which the action of the ordinary, fine-wire carding machines is too severe.

Ecologically, the teasel is a product of the heavy loams and clays, a gross feeder which flourishes under moderate rainfall. It is certainly a very old crop in this part of Somerset. While it may have been grown on some scale long before, it is probable that teasel-growing as an ancillary husbandry to the cloth-making trade received its first big boost from the production needs of the finer woollen weaves which followed the settlement of the Huguenot cloth-makers in England. Teasels were also certainly grown on the hinterland loams of the Gloucestershire and Wiltshire cloth-making areas. Arthur Young mentions them as being grown on heavy land in Essex, where they were cultivated in conjunction with the fetid-smelling coriander plants. But only in Somerset has teasel-growing survived to the present day.

Soil and climate apart, there is one unique factor which may have contributed to the survival of the Somerset teasel. Much of the teasel-growing is on "teart" land, the soil of molybdenum excess. In the days before copper sulphate had made the "teart" safe for cattle, the teart-land farmers would certainly have been more concerned with maintaining a maximum acreage of a lucrative cash crop than their more fortunate neighbours and farmers elsewhere, on good stock-rearing and dairying land. These ecological factors, fortified by generations of local tradition and skill, and the sustained demand of the Northern cloth mills, are probably the principal reasons why the Somerset teasel has survived whilst the local cloth-making industry which they formerly served has died out.

Cultivation Teasels are sown as seed—it looks like carraway—with a root drill in March. They like a fine tilth, and go in at about 4 lb. to the acre. In six weeks the crop is normally up in drills and can be horse-hoed to check the weeds. After this the husbandry is as for roots, the teasel plants being singled to about 4 inches apart and the crop kept clean with hand- and horse-hoeing. Two or three cleanings are desirable. By the end of October the plants are ready for transplanting, for the teasel is a biennial and takes about eighteen months to reach harvesting maturity.

The teasel plants are lifted with a special tool called a "spitter" (a short, tapering iron with a walking stick handle and a sharp, cutting end) which is inserted under the plant and, by severing the long taproot, prises the plant from the earth. The field destined for the transplants is ploughed as early in the autumn as possible and the plants—about 12,000 to the acre—are dibbled in on every third furrow. This gives 30 inches between rows, the plants being 24 inches apart. At every third row, a furrow is missed, which leaves narrow gangways through the crop for use at harvesting time.

The care of the teasel fields from planting to harvesting is principally a matter of hoeing by horse and hand. The crop is usually worked through three times from April onwards. In their second year the plants throw up a main stem and numerous side branches crowned by the prickly cylindrical heads, which come into flower about the middle of July and are ready for harvesting from the first or second week in August onwards.

Much of the uncertainty has been removed from the growing of the crop through the work done in the last decade by the Provincial Entomologist's Department in the South-West. Growers had long complained of severe losses among the plants at lifting time. Up to 50 per cent of the crop had not infrequently to be written off, and of the remainder a considerable percentage was composed of malformed, squat, "cabbagey" plants which produced soft, useless teasels. These losses occurred despite long intervals between successive teasel crops. The causative organism was found to be the "oat race" Stem eelworm, which explained why the trouble had not been controlled merely by resting the fields between crops. The eelworm cycle was being continued on a variety of hosts—mangolds, beans, oats, and on many weeds such as chickweed and cleavers.

The pest was also being perpetuated by the use of infested seed. The collection of seed has tended to be haphazard, often consisting of the sweepings of the seeds from the shed where the teasels were stored and packed. Progressive practice today is to get the seed from the best crop in the district each year—it is usually free—and to steep it for twenty minutes in a half per cent solution of chlorophenol in water. The seed is then dried with sand and sown the following day. This treatment (as with clover), plus keeping down hedge weed hosts, not following the crop with beans or oats in the rotation, and allowing a gap if possible of up to seven years between croppings, has proved highly successful in combating eelworm. (It is of academic interest that the eelworm was first isolated as a teasel pest in Germany in 1880.) The other principal pest identified and now treatable is the "teasel leaf miner", a small black fly which lays its eggs on the leaves and which hatch out into maggots associated with severe bacterial rots. This is now controlled by two DDT dustings in August. The plants are also subject to attacks by the virus of Cucumber Mosaic, producing the characteristic severe leaf mottling and stunted growth, and the fungus known as violet root rot, which destroys the taproot of the plant. But these are met much less frequently in a normal season.

From Field to Factory The harvesting of teasels—incidentally a very prickly task!—is done by cutting the individual flower-heads with a crescent-shaped knife (usually made from old scythe blades) thonged to a thick glove and held in the palm of the hand. The heads are severed about a foot down the stem—to a casual observer it looks as though they are being picked, for the knife is completely hidden in the gloved hand—and transferred to a bunch being made up in the left hand. A good plant will yield between 40 and 50 heads, and the cutters go over the crop several times to complete the harvesting. An acre should on average yield about 200,000 heads, but it is highly probable that with seed selection from the best plants, more uniform crops with higher yields could be obtained.

The completed bunch or "handful", the primary unit of teasel measurement and comprising fifty teasels, is then tied with a teasel thong and tossed into the wide gangway running through the crop every third furrow. At the end of the day's cutting, the bunches are put on "teasel poles" about 10 feet in length, with a wooden cross-piece at the base. The thin end of the pole is pushed through the bunch thong, which is then slid down until it rests on the cross-piece, and the pole is covered from end to end with bunches arranged in circular fashion. A pole carries on average twenty-five bunches, or 1,250 teasel heads, and weighs approximately 1 cwt. A first-class piece-work operator will cut, bunch and pole 15,000 teasel heads in a dawn-to-dark routine.

These poles are laid against rough timber racks, consisting of uprights and cross-bars, placed at intervals around the field. There the teasels are left to be dried by the sun and wind for about a week. If the weather is bad, they are taken into open-ended sheds, for the heads mould quickly if exposed to too much dampness.

After drying, the loaded teasel poles are stored on the farm through the winter, ready for the northern teasel factors in the spring. The latter supply big canvas sheets for the crop, and the teasels are dispatched from the farm in these "packs", each of which will contain 20,000 heads. Formerly, the crop was size-graded into "Kings", "Middles" and "Smalls" and priced accordingly, but nowadays the custom is to sell them at a flat rate. Arrived at the premises of the teasel factors in Yorkshire, the heads are trimmed and clipped, then sold to the textile mills. It takes approximately 3,000 heads mounted on the gig to tease up the nap on a 75-yard roll of cloth.

The biggest part of the Somerset crop is now grown right through by the farmers themselves, but before the war it was common practice for farmer and worker—either one of his own men or a casual worker—to enter into a partnership on the crop. The farmer provided the land and the equipment, and carried out the major cultivations, while the partner took responsibility for the crop from sowing to harvesting. The latter found the labour for cutting, and the farmer and the partner shared the harvesting costs and eventually the profits.

The teasel shows little or no response to fertilizers, though a small-scale investigation is now being carried out locally by a fertilizer firm on this aspect. It often follows grass or roots folded with sheep. The crop has traditionally been recognized as a gross feeder and many landlord/tenant agreements on these Somerset farms set a limit to the annual acreage which may be devoted to the cultivation of this specialized crop.

MARKETING FORCED RHUBARB

D. J. McCOWARD, B.Sc.

Ministry of Agriculture, Fisheries and Food

A survey of the methods of marketing forced rhubarb grown in Cheshire and Yorks W.R. was made last year. It appears that greater uniformity would be to the growers' interests.

FORCED rhubarb is the first home-grown "dessert" produce of the year. Most of the crop is marketed between January and Easter, although a little may be sold as early as the end of November and the season can extend to the beginning of May. The greatest volume comes from the Leeds-Wakefield area in the West Riding of Yorkshire and is sent all over England; Cheshire also produces a fair quantity, most of it being sold in nearby markets.

Virtually the whole of the Yorkshire crop is forced in specially built sheds. As it comes to maturity, the crop is pulled over at suitable intervals by skilled workers, and all the fully developed sticks are removed together and carried to "tying sheds", where they are prepared for market. The sticks are generally cleaned and graded by women working on a bench placed, wherever possible, under a window so that the work can be done in the best light available. To minimize damage, the benches are usually covered with some soft material.

Varied Marketing Methods in Yorkshire Nearly all the sixteen Yorkshire growers visited last year practised some form of quality grading. Very poor quality unmarketable sticks are usually dumped on the floor and swept outside at intervals, and the marketable produce is then generally further classified into different grades—usually "bests" (or "firsts") and "seconds". Most growers putting up two grades select "bests" mainly on the basis of size, although shape, colour and mechanical damage may also be taken into account. Some packers attempt to maintain a uniform standard throughout the season for their top-grade produce; others vary the "best" grade according to the requirements of the particular market to which the produce is to be consigned.

A few packers put up three grades by adding a "super" category, composed of the largest best quality sticks. One grower mixes first- and second-grade sticks in 1 lb. bundles to make a single commercial grade.

The practice of marketing forced rhubarb in bundles disappeared during the war, and in the West Riding the practice has not been revived to any great extent. Most growers nowadays pack the whole of their crop in bulk, the sticks being laid end to end and alternately reversed with leaves at opposite ends of the box to give a more even fill.

Only one grower was found who put up his whole crop in 7 lb. bundles, made up by using a felt-lined iron cradle, and secured with a gummed paper wrap. A very much smaller bundle, nominally 1 lb., was used by a few growers, in some instances for the whole of the crop, and in others only for "seconds". These bundles are made up of a handful of sticks, which are secured at top and bottom by fillis or elastic bands. Elastic bands make for speed in packing but are considered by some growers to be more likely to damage the sticks.

Both returnable and non-returnable containers are used. The former are generally based on the well-known "West Riding" box (28 inches × 11½ inches × 7½ inches), strongly made, with a heavy lid which frequently is hinged. Such boxes may be the property of the grower or his salesman. In general, the use of returnables appears to be restricted to the larger growers, many of whom own their own: a salesman's empty was rarely seen. For a grower to use his own boxes involves him in high capital outlay, requires off-season storage space, and calls for a lot of clerical work. Such boxes, however, are specially designed for the crop and offer excellent protection to an easily damaged product. In addition, they fit in well with the marketing plans of a grower who takes produce to market on his own lorries, which would otherwise lack a return load. Some growers prefer to use returnables if sending to market by road, and non-returnables for rail transport.

Most growers seem to like non-returnables. In all but a very few instances these containers have not primarily been designed for the job, but are adapted on the spot from once-used, non-returnables of various kinds. Egg boxes, various kinds of citrus cases, apple and pineapple boxes are bought and either used as they are or modified to suit the requirements of the individual grower and his market. These modifications may perhaps involve only the removal of a central partition, or occasionally a large egg crate may be cut into two. Most of these boxes need altering in some way, and although they may be cheap to buy, the costs of repairing, altering, and storing must be taken into account when comparing price with other containers. An added disadvantage is that the supply of a popular type of container may suddenly cease, and the users are forced to switch to other, and perhaps less suitable, types. Moreover, all of these boxes are without lids, and rigid lids to fit them are not made, so that the sole protection is packing material.

Several attempts have been made to introduce specially designed card or fibreboard containers, but these have not been very successful, since the long narrow shape demanded by the product does not suit this material. One grower has developed a non-returnable, sawn wood, open container, which was tried out for the first time in 1955. The basic cost is higher than for the once-used box, but it can be stored in pieces, and making up is a simple matter.

As would be expected from the variety of containers used, a wide range of weights was encountered. The basic unit appears to be the "half stone" (7 lb.), and containers are usually packed to some multiple of this. The usual returnable takes 28 lb., but others may hold 35 or even 42 lb. With non-returnables of the once-used type, the range is from 20 to 56 lb. A pack of 28 lb. was most common, but net weights of 30, 35, 42 and 49 lb. were also seen. One grower using cartons, packed in 14 lb. lots.

A few growers made allowances for loss of weight in transit by packing a pound or so over the declared weight; most did not. Packing materials for lining the boxes varied considerably. Old newspapers, sulphite tissue, greaseproof paper, white paper, straw, and corrugated cardboard were all seen, either used alone or in various combinations.

Bundling still Common in Cheshire A brief visit to five growers in the South Manchester district revealed that most of the forced rhubarb there is produced in glasshouses on general horticultural holdings. The houses are either completely blacked out, or the roots are forced under darkened staging. Selective pulling, where pickers work at least twice over the beds, or sorting into grades while

pulling, are common practices; bulk pulling was not met so frequently. Thus grading is generally not associated with packing, as in Yorkshire. All the growers visited graded their marketable sticks into "firsts" and "seconds", and, in addition, two put up a third grade of "smalls".

Bundling appears to be much more widely practised, some growers bundling all their produce, and the rest at least one of their grades. In contrast to Yorkshire, the bundle unit is 6 lb. Some third-grade sticks were put up in handfuls secured by two elastic bands.

Returnable boxes seemed to be much more generally used in this area. Flower trunks with lids were popular; others seen included the "Cheshire" box—without a lid but with corner pegs—and reclaimed fish boxes, also lidless. Net weights ranged from 18 lb. (3×6 lb. bundles) to 36 lb. of bundled smalls; the most usual pack was 24 lb.

Room for Improvement Forced rhubarb is a very tender crop and highly susceptible to damage, which may not only affect the appearance but also lead to rapid deterioration during marketing. Handling should be reduced to a minimum, and every care taken during harvesting, grading and packing to maintain the product in good condition. For this reason, ignoring the physical difficulties of working in limited space and poor light, bulk pulling seems preferable to selective picking. Grading and packing benches should always be covered with soft material, preferably of a kind which can easily be wiped clean, and containers should be lined with ample packing material to give protection in transit.

Bundling involves extra handling and tying, with increased chances of damage. This process is also time-consuming and, therefore, more costly. Large bundles, in particular, lower the maximum net weight which can be packed in any kind of container and also tend to prevent full inspection by buyers in wholesale markets. The advantages claimed for bundling—that it avoids the need to allow for the weight of containers and that it allows buyers to purchase in small units—would not seem to have much force, and there appear to be no sound reasons for continuing the practice.

The very wide range of packages used and net weights packed undoubtedly complicate the marketing of forced rhubarb. In a small packing shed the simultaneous use of several different containers, which must be kept separate for stacking, weighing and packing, may leave little room for other operations, and the same difficulties must arise in wholesale markets. The survey and observations in wholesale markets suggest that selling is further complicated by the fact that few growers label their packs adequately—if at all. The net weight is rarely shown, and indications of variety or grade are even rarer. In addition, the fairly widespread practice of packing to an exact net weight on the holding does not allow for loss of weight in transit, which may be aggravated by stacking packed boxes for considerable periods in warm tying sheds, and by the use of hygroscopic packing material. Some growers in Cheshire sprinkle water on newspaper-lined boxes before packing in an attempt to reduce loss of weight.

Box linings should be adequate and clean. Newspaper alone is not recommended, and clean sulphite or greaseproof alone, although looking better, does not provide sufficient protection. Well-grown forced rhubarb is an attractive crop, and the appearance of a pack, as well as the quality, can be greatly enhanced by the use of suitable packing materials.

The standard of grading varies considerably, and although packers may justifiably claim that their salesmen are familiar with their grading and packing methods, this knowledge can hardly extend to buyers.

Thus in a highly specialized and localized industry there is an almost bewildering range of marketing methods. There appears to be a good case for a greater degree of uniformity to be developed by the producers themselves. With containers, for example, the trend is towards the use of non-returnables, but most are used imported boxes, of which regular supplies cannot be guaranteed. These are admittedly cheaper to buy than other types, but it is doubtful whether due allowance is made for labour and materials incurred in adapting them or for storage costs. It is easy to understand the desire of a grower to cut his marketing costs to the minimum by economizing in packages and packing and labelling materials. Care must be taken, however, to see that cost-cutting decisions are justifiable, and that a good product is not spoiled for the want of a ha'porth of care.

FARMING AFFAIRS

Oxford Farm Conference The Oxford Farming Conference is one of the brightest stars in our agricultural firmament and is now, in its tenth year, acquiring an *alma mater* atmosphere. The focus of interest this year was never far away from the really important questions that are uppermost in farmers' minds, and it is just because this practical quality is so clearly in evidence that the Oxford Conference is such a success.

Thus C. CULPIN (N.A.A.S. Liaison Unit at Silsoe) spoke of the possibilities which bulk grain storage offers to the small, as well as the large, farmer. "The bagger combine," he said, "needs one man to take off and tie up the sacks, whereas by the bulk handling method, one man can often do the whole job of grain transporting if a reserve trailer is parked at one corner of the field. Where the tank method is generally less suitable, is for very long transport distances. On the whole, I think that many farmers must have been scared off bulk handling by ill-considered arguments which assumed that another tractor and man in addition to the combine operator must always be in the field when the combine empties its tank. I believe that there will be a gradual increase in the use of tank machines, but with almost 20,000 bagger machines now on farms and more small machines being sold, there are unlikely to be any rapid changes in the proportion of tank type machines."

M. H. R. SOPER (Dept. of Agriculture, Oxford University) reviewed the trend in the designs of milking parlours, with special reference to the conversion of old buildings. He claimed four essential principles in design—it must promote efficiency in the use of labour, aim at contentment of both man and cow, produce reasonably high yields, and be such that disease, particularly mastitis, can be kept under control.

W. E. CAVE (Marlborough, Wilts) underlined this importance of milking parlour design by reference to his own early experience and said that many of the improvements to dairy layouts being made today are totally inadequate. He posed the question whether the saving in capital and labour in the yard and parlour outweighs the extra cost of litter and the lower yields which are usually associated with it. "There may be a case," he said, "for a yard and parlour for a large herd on an arable farm where straw is plentiful, or where the cows lie out all winter. But for herds of 30 cows or less, housed in winter, and where straw is not plentiful, I think a well-

designed cowshed, where higher yields can be obtained, would be a better proposition."

In his paper on milk cooling and handling, H. S. HALL (National Institute for Research in Dairying) speculated on the adoption of bulk milk handling in this country. Apart from the elimination of handling after cooling, he thought that the bulk system should not affect farm operations very deeply. The great difference comes in the change to refrigerated cooling. "Refrigeration will cost something of the order of $\frac{1}{2}d$ per gallon of milk. Water cooling normally costs about 0.05*d*. per gallon. This large increase of cost, automatically involved with the bulk system, must of course be paid for by an equivalent—or preferably bigger—saving, if the method is to spread. Transport to the first destination is paid for by the farmer, the present rate being around 1*d*. per gallon. A tanker will have about twice the payload of a lorry carrying milk in cans, but is more difficult to keep at near-maximum capacity throughout the year. The difficulty of clearing an area with bulk handling is obvious when one looks at the great variation in farm size. Different categories of milk add complication. So the savings in first-stage transport costs are not likely to make more than a small contribution towards the cost of refrigeration at the farm."

And so to beef, when J. W. FRATER (Alnwick) spoke of modern production methods. He called for smaller and higher quality carcasses. "It does not necessarily follow," he remarked, "that because they are smaller, they are of higher quality, but it is a fact that generally youth and light weight avoid excessive fatness, coarseness and large joints. More than that, in the younger bodies we find more beef in the proper places."

To meet the modern market, many more high quality beef stores will be wanted. "This supply can only come from the single-suckled calf herds, such as are being developed in the Scottish and Welsh border counties, and also the highlands of Scotland. . . . The suckled herd is not very exacting in its requirements as to conditions and environment, and much of the land in the United Kingdom and Northern Ireland, carrying at present a low cattle population, could easily be adapted for this purpose."

The full report of the Conference (with discussion) will be available by early April from the Secretary, Mr. M. H. R. Soper, Department of Agriculture, University of Oxford.

Farm and Forest: 11. Planting Forest Trees

Having chosen the species of tree and thoroughly prepared the site, the next point to consider in establishing the new wood is the best method of planting. The most suitable method is quite simply that which, in the conditions prevailing, will most favour the development of a healthy crop of trees, without undue check in the growth of transplants. A quick method may be favoured because of its cheapness, but it should never take precedence over efficiency. Badly planted trees may appear satisfactory for a few seasons, but the effects will always be seen in a later stage in the plantation—in poor growth and windthrow—simply because the roots were so bundled up in the process of planting that they failed to recover properly.

The depth of planting is most important. Normally it should be such that the "collar"—that is, the junction of the stem and the roots—comes just at ground level. Planting too deeply, or not deeply enough, will impair the ultimate success of the plantation. Spruces are particularly prone to a long period of check if planted too deeply, and the same applies to various hardwood species. Rather deep planting may, however, be justified on light soils. Pine on very light soils, for instance, have been more successful when planted deep, owing to the movement of the surface soil and the possibility

of sun-scorch to the tender collar area. Where the surface soil is bracken humus, trees such as larches should be planted with the collar well down into the level of the real soil.

The method of planting should be such that the roots develop in the same manner as they would have done had a seed been sown and allowed to grow naturally. Hardwoods, the majority of which are strongly tap-rooted, should be put straight down in a deep pit or notch. A small, lightly rooted tree, such as Douglas fir or larch, should be planted so that the roots will spread freely outwards and downwards, thus encouraging regular development and avoiding future troubles from windthrow. The spruces, which are surface-rooting trees, should have their roots spread laterally all round.

Although the importance of a good system of root disposal to ensure proper establishment has been stressed, the need for economy must not be overlooked. Undue trouble to secure 100 per cent survival is not worth while; it is quite satisfactory if 90 per cent of the plants survive, provided the losses are not so grouped as to leave large gaps which will not close within a reasonable time.

The surest way of getting the planting done in the way that best suits the land and young trees is for the owner himself, or his representative, to be constantly trying and timing different methods and watching the results. This will always mean a good deal of trouble, but without it the owner may find that, after a short period with no supervision, his men are planting as if each young transplant (costing a few pence) were a cordon apple!—and that means steeply rising costs. The ideal is to keep a balance between over-refinement of planting, which is costly, and inefficient planting, which results in expensive replacement of dead plants and extra weeding.

S. J. C. West,
District Officer, Forestry Commission

Association of Agriculture We are living an age of the atomization knowledge, said Professor E. G. Bowen of the University College of Wales at the Members' Meeting of the Association of Agriculture in London last month. The more society progresses, the more intensified becomes the specialization of its diverse activities, until we are in a very real danger of losing sight of the whole by the obtrusion of the part. Professor Bowen was looking at the relationship between urban industry and the land, and stressing the dangers that accrue when the two are not in balance. Whereas a hundred years ago the urban and rural populations were about equal, today 84 per cent of the people are living in urban areas. Thus, said Professor Bowen, in these circumstances there could easily be much less consciousness among the majority of the people of the fundamental importance of British farming. Much of our food in these days enters the home processed and packaged, which tends further to disguise its primary character. Food must never be thought of simply as a right. For all that under modern conditions specialization tends to fragmentation and what Professor Bowen called "laboratory techniques", the partnership between man and the land is as indissoluble today as ever it was.

It is in the field of promoting such knowledge that the Association of Agriculture is playing such an important part, and accordingly well merits the support of all who are in any way concerned with the agricultural industry or who wish to see a true balance between factory and farm. Mr. Colin Hurry, Chairman, said that the Association is at present having to draw heavily upon its reserves. Much more financial help is needed if the Association is to continue and extend its work. Membership costs two guineas a year, and the Association's address is 53 Victoria Street, S.W.1.

Winter Spraying to control Brambles Brambles in brush or scrub or on pasture land are a curse to the farmer. Cutting and burning are generally unsatisfactory ways of dealing with them, for fresh canes will invariably spring up from the roots; and removal by modern brush-cutting and earth-moving machinery, though efficient, is costly. Chemical control with herbicides such as 2,4-D and 2,4,5-T may well be the answer.

The choice of the time to spray is important. In summer it is possible to be selective, since, although brambles and some other woody species (such as hazel and broom) are susceptible, the valuable whitethorn and blackthorn are moderately resistant. This is fortunate when the subject is a useful hedgerow in which it is desirable to keep the thorns while getting rid of the brambles. But if the idea is just to destroy woody weeds about the farm, then winter spraying in oil should be the aim, for at this time of the year all the woody plants will succumb to, or be severely stunted by, these hormone "brush-killers".

And what a convenient and cheap operation this winter spraying can be! The work is done at a time when the sprayer would otherwise be idle and when the farm staff may be short of outdoor jobs. It can be carried out in any weather, and the only additional equipment needed is a length of pressure hose and some form of hand-lance or spray gun (as shown in our cover photograph). The only real worry is the cost of the oil. But, by using small nozzles (say, $^{3}/_{64}$ inch) the spray can be made to cover a lot of woody growth, since there is little leaf to absorb it. Moreover, in winter the oil will carry the herbicides at a much greater concentration than it can in summer.

Brue Valley and Northmoor, Somerset The Minister has issued a Report* made by the Agricultural Land Commission under Section 68 of the Agriculture Act 1947 upon the action necessary to enable full and efficient use to be made of these areas. The Brue Valley, lying between the Polder Hills and the foothills of the Mendips, is some 5 miles wide and runs 15 miles inland from Highbridge on the coast to 3 miles east of Glastonbury. It is an area rich in legend and history, particularly of the Holy Grail and the exploits of King Arthur, and remains of the Iron Age lake villages have been found. More than half of the area is only 10-12 feet above sea level. There is evidence that the first barriers against the sea were built along the coast by the Romans, but despite continued efforts to protect the valley throughout the centuries, it was inundated as recently as 1872, and even now some 7,000 acres are liable to flood during adverse conditions of rainfall and tides. The valley is drained by a complex system of ditches or rhynes, draining mainly into the River Brue. Dairying is the principal industry, and the low-lying moors are almost exclusively used for summer grazing and haymaking.

Northmoor comprises some 3,500 acres of separately named moors lying in the triangle made by the River Parrett, the Taunton and Bridgwater Canal and the Taunton-Glastonbury road. Here, also, the centre of the area is peat moorland, and over 90 per cent of the agricultural area is given over to milk production.

The Commission consider that the present system in which dairy farming predominates is the best for the area, but in their opinion there is nonetheless great room for improvement and they recommend measures for increasing the efficiency of the drainage, for better access for farm traffic, and for a campaign to improve the management of both stock and pasture in the areas.

* Land in the Brue Valley and Northmoor, Somerset. Report of the Agricultural Land Commission. H.M.S.O. Price 2*s.* 6*d.* (2*s.* 7½*d.* by post).

Forty Acres for Milk A Warwickshire farm of 40 acres furnishes an interesting example of what grass can do under good intensive ley management. Mr. Boddington is the farmer, and his main source of income is milk from an attested Ayrshire/Shorthorn herd. Over the last five years the herd has been increased from twelve to twenty, the yield average raised from 682 gallons to 750, the total milk production increased from 7,996 gallons to 13,725, and his net profit per acre more than doubled. All this mainly from grass—strip grazed and conserved.

With the exception of a little kale, the whole farm is in grass—most of it 3-4 year leys, with always 5-6 acres of one-year Italian ryegrass: the cost—£15 an acre, which includes rent, labour, fertilizer and the ley establishment quota. As much as 5 cwt. sulphate of ammonia, 5 cwt. low-grade basic slag and 2 cwt. muriate are given per acre, and although therefore the fertilizer bill is heavy, the return has amply repaid him. First-class silage is made in a pit sited under the Dutch barn and thus ready to hand for feeding.

The story of this small farmer's success is clearly and convincingly told in a new colour film, "Barnmoor Farm", produced by the Plant Protection Film Unit and available for borrowing in 16 mm. from Imperial Chemical Industries, Ltd., Bolton House, 61 Curzon Street, London, W.1. Running time: 20 minutes.

Forestry Courses On the 15th of this month a number of woodmen will be taking up their axes and joining a six-weeks' course arranged by the Forestry Commission on the Chatsworth Estate—the Derbyshire home of the Duke of Devonshire. They will be followed on April 4 by a second contingent, who will be in residence until May 16. There are no fees for these courses, and board and lodging costs and allowances will be met by the Commission.

Two courses for woodland owners and agents are also planned to take place at Northerwood House—a large country house in the New Forest—on March 5-10 and June 11-16. Here a moderate fee to cover accommodation, board and transport is payable.

In both instances the aim is quite simple—to increase the forestry knowledge and skill of those on whom the rehabilitation of our war-felled and often unproductive woodland depends. Places are still available on both types of courses. Applications or inquiries about them should be made to the Chief Education Officer of the Forestry Commission, 1 Princes Gate, London, S.W.7.

O.E.E.C. Essay Competition The European Productivity Agency of O.E.E.C. is offering trips to its Paris headquarters and tours in various European countries to the winners of an essay which is open to students of universities, technical colleges and evening classes recognized by the Ministry of Education. The essay, which should concentrate on productivity rather than on economic factors, must not exceed 4,000 words and should describe a factory or enterprise (including an agricultural enterprise) where a considerable increase in productivity has been obtained by introducing new methods or techniques.

Candidates should be under 27 years of age on December 31, 1955. Full details may be obtained from the British Productivity Council, 21 Tothill Street, London, S.W.1. The closing date for entries is March 7, 1956.

Soil Fertility Conference at Exeter Strong criticism was levelled at farmers who burnt straw instead of returning it to the land by PROFESSOR H. G. SANDERS, Chief Scientific Adviser to the Ministry of Agriculture and principal speaker at the morning session of the Soil Fertility Conference held in Exeter last month. This waste could go on for a number of years without repercussions, but there would ultimately come a time when the land would suffer as a result of this loss of organic matter. Undoubtedly the best method is to turn the straw into muck, and with better methods of distribution there is no excuse for such appalling waste by burning.

Professor Sanders went on to point out that "humus is the key to fertility, and the incorporation of organic material in the soil is thus essential. Not only does humus release N,P,K, and minor elements, but it has a valuable effect upon soil structure." The necessary plant foods are not, however, maintained in sufficient quantity by humus alone and consequently fertilizers have to be used. Increased plant growth resulting from the application of fertilizers ultimately produces more humus, so that the effect is cumulative. Muck and fertilizers are, in fact, complementary. "We are not," he said, "using enough fertilizers in this country. Three to four times the quantity could be applied with advantage."

The afternoon session was opened by DR. J. D. IVINS, of the University of Nottingham, who maintained that farmers should increase their incomes, not by cutting costs but by increasing both the quality and quantity of their produce. Choosing the right variety, sowing at the proper time and using fertilizers wisely, all play their part in increasing soil fertility and, in turn, profits. Dr. Ivins laid particular stress on the potentialities of the potato crop. Potato yields in 1955 were, he said, closely related to the amount of water the crop received. In Lincolnshire, irrigation had doubled yields. Delayed planting often meant a reduction of a ton or more an acre. Planting depth should also be studied, for some varieties give larger tubers when planted deep. He remarked that wider spacing plus fertilizers gave better results than close planting without fertilizers. Economy in fertilizers could be achieved by placing in the rows rather than broadcasting.

MR. D. S. LEWIS, of Imperial Chemical Industries Ltd., in his paper "The Economies of Grassland Production", stressed the importance of grass as the biggest single crop in the country. Properly managed, he said, intensively farmed grass is very cheap and profitable. Balanced manuring is essential, and the making of silage a very important factor in management. The correct use of fertilizers, particularly nitrogen, had enabled farmers to get practically the whole of their summer milk production from grass alone, and, conserved as silage, had reduced the winter feed bill tremendously. Dairy farmers must aim at producing milk at lower cost, and this could best be done by making much greater use of better quality grass. An output of 350 gallons per acre should be a target; at present, the national average was only about 200 gallons.

The Conference, which was attended by over 350 farmers from south-west England, was organized by the National Agricultural Advisory Service, in conjunction with the Western Region of the Fertilizer Manufacturers' Association.

K. M. Pearman

IN BRIEF

The Worm Burden

Stomach worms in sheep and lambs build up over the spring and summer. Heavy infestation can be prevented by dosing with the drug phenothiazine six weeks after lambing and continuing the treatment at monthly intervals during the summer. Routine dosing reduuces the worm burden of the sheep, and in consequence, fewer worms' eggs are passed out with the droppings on to the pasture.

Phenothiazine can be obtained in the form of 5 g. tablets, or as a specially prepared powder which can be mixed with water immediately before dosing and given as a drench. Always give the tablets by means of a balling gun. The drench may be given from a bottle, but it is more easily administered by a drenching gun made specially for the purpose. Hold the sheep in the standing position, with the head held so that the nose is only slightly raised. With the bottle method, the drench should be given slowly, and care taken to avoid spilling the liquid on the wool, since it will cause permanent staining. Dosages are as follows: lambs 1-3 months old, ½ oz. or 3 tablets; ewes and lambs over 3 months old, 1 oz. or 6 tablets.

During the last few years a severe form of worm disease, caused by *Nematodirus*, has been recognized in lambs. The animals may be affected when only six to eight weeks old. Older lambs and adult sheep are more resistant. The disease shows up by severe scouring, and heavy losses sometimes occur. It appears to be associated with second- or third-year leys, and a sound preventive measure seems to be to reserve a first-year ley, ungrazed by sheep, for the lamb crop. Various treatments have been tried, but none appears to be efficacious.

S S S

Pigs on Lucerne

Advocates of lucerne as a good source of grazing or "green meat" for pigs receive support for their views from work in progress at the Ohio (U.S.A.) Agricultural Experiment Station.

In experiments that have so far involved some 80 pigs, it has been shown that when a diet is supplemented with 18 per cent of lucerne, or alfalfa as the Americans call it, fed cut and sun-cured, there are considerable advantages over an apparently equally good ration free from lucerne and other leguminous products.

While the inclusion of lucerne does not apparently affect the ability to conceive, it increases very significantly the numbers of live pigs farrowed and the survival of pigs to weaning age. The mean number of live pigs born per litter has been 9.83 for the sows and gilts receiving lucerne, and only 8.64 for the control animals. In other words, the feeding of lucerne has yielded over one additional live pig per farrowing.

Following farrowing, losses have been lower in the progeny of the lucerne-fed pigs, averaging 13.8 per cent to eight weeks, as compared with a slightly higher figure in the controls. The advantage of lucerne feeding is therefore a real one in so far as the numbers of weaned animals are concerned.

These results were obtained with cut and dried alfalfa, but there is no reason to suppose that the factor or factors concerned are not in fact present in fresh-growing lucerne, possibly in higher concentration.

Pig Farming, January 1956

More Milk for Beef Calves

When circumstances permit, it might be worth considering whether moving calving dates forward might not be an advantage in providing more milk in pure-bred beef cattle. By calving early, the flush of milk when the grass comes would provide more milk when the calf is large enough to take it and would also provide a longer period of grass feeding for the calf before it has to go on winter rations.

Commercial herds of pure beef cattle might also adopt something of the methods employed in the dairy industry. By not letting the heifers get too fat before mid-pregnancy and by raising their plane of nutrition during the period before calving they would grow better udders and produce more milk and, as a consequence, not put on too much fat again in their following pregnancy. . . . There is fairly good evidence that more growth can be got out of a given quantity of milk in this way than by pail feeding; and in addition there is a saving in expert labour.

Dr. John Hammond at the Farmers' Club

Lucerne and Cocksfoot in Balance

When cocksfoot is grown with lucerne, it is important to preserve a balance between them. Two experiments were conducted at the Reading University Farm, Sonning, expressly to study (1) the effectiveness of cutting such a mixture at various dates in the autumn and winter and (2) the effects of winter and early spring grazing.

The results from these two experiments are strongly in favour of removing herbage, either by cutting or by grazing, during the winter. In addition to providing valuable keep from late October onwards, this practice improves the status of the lucerne in the following spring and summer. Winter grazing is therefore all gain.

Lucerne appears to react unfavourably to grazing in mid-April. The indications are that the plant continues to draw on its reserve foods for several weeks after the shoots begin to grow, and that if the herbage is removed before this phase has passed, the plant becomes weak. It is then less well able to compete with cocksfoot, even though the grass itself is held in check by grazing in April.

Farmhouse Cheese

The ancient craft of farmhouse cheese-making, which has given us such colourful names and delectable products as Cheshire, Cheddar, Caerphilly, Double Gloucester, Stilton, Leicester, Dorset Blue Vinney, Wensleydale and Lancashire, is today but a shadow of its once robust self. Many people have forgotten the taste of farmhouse cheeses, and a new generation has grown up that knows little, if anything, of them. Before the war over 1,000 farmers, mainly in Cheshire and Somerset, made cheese on the farm: today there are about 150. The supplies are small, but of first-class quality.

The Milk Marketing Board has been busy in the past eighteen months or so, since controls have been taken off, trying to re-establish fine quality farmhouse cheeses and give them a country-wide distribution. About one-third of the total United Kingdom cheese requirement is being met by home producers, and most of it is made in creameries. The M.M.B. is doing its best to revive some of the old, well-known varieties, and in one of their creameries they are already making Double Gloucester—a real connoisseur's choice.

Protection of Farm and Forest Workers

The protection of agricultural and forestry workers against risk of bodily injury and injury to health in the course of their employment is the aim of the new Agriculture (Safety, Health and Welfare Provisions) Bill. The Regulations which the Agricultural Ministers will so be enabled to make may deal, among other things, with the safeguarding of workers from dangerous parts of machines, with the training or supervision of young persons when working with prescribed machines, and with the protection of workers from the risk of falls and strains. The Bill also makes provision for notices to be served requiring the provision of sanitary and washing facilities where existing facilities are inadequate; and the Ministers may make Regulations for the provision of movable sanitary facilities where workers are employed by a contractor or other person who is not the occupier of the land on which the workers are engaged.

In addition, the Bill provides that children under thirteen years of age may be prohibited by Regulations from riding on or driving prescribed vehicles, machinery or implements used in agriculture.

Cheaper Cleaning of Milking Equipment

The cost of cleaning and sterilizing milking equipment in herds of about 15 cows has been estimated at 1*d*. to 3*d*. per gallon of milk. Labour is the largest single item involved. A method of cleaning equipment which reduces labour, and at the same time other items of cleaning costs, has recently been developed and tried out on a number of commercial farms by the National Institute for Research in Dairying. The method is mainly appropriate for "direct-to-can" milking and consists essentially of immersion of all parts which come into contact with the milk in a cold caustic soda solution for the whole period between milkings. With no brushing or steam sterilization, it was found possible to produce consistently milk of good quality, although the bacteriological standard of the clusters was not up to current standard, and further work on this aspect is required.

Cold Storage of Flowers

Successful American trials with the cold storage of flowers point to a combination of pre-packaging and dry cold storage. The flowers are best packaged immediately after cutting (no temperature conditioning or standing them in water), and speed is really essential to prevent too much moisture being lost. Transparent film wrapping is used to enclose the flowers in a sleeve, the ends being folded over and sealed with cellulose tape, and the free air space kept to a minimum. The packages are then stored at a steady 31°F.

When the flowers are taken out of storage, their stems are cut before placing them in water at 100-110°F. in an air temperature of 40°F. for 6-12 hours. This hardening treatment, it is claimed, greatly improves the quality. The flowers may then be packed and marketed in the same way as freshly cut flowers.

BOOK REVIEWS

Fertility Pastures. NEWMAN TURNER. Faber. 18*s*.

Mr. Newman Turner is well known as a protagonist of the "organic" school of farming, but only an insignificant part of this book is concerned with the pros and cons of this well-worn theme. It is much more a book full of original thinking written by a practical farmer who has made a success of carrying out his own ideas. He is quite obviously an assiduous observer, as well as being a first-class stockman by instinct as well as experience. Therefore the book can be confidently recommended to anyone who is trying to use his pastures as well as he can, irrespective of any prejudices he may have for or against fertilizers.

The general theme of the book is that quality, as well as quantity, in what we feed to farm animals has something to contribute to the financial success of livestock husbandry, and it is surely high time this point was made. Mr. Newman Turner is a warm supporter of using complex pasture mixtures, including herbs such as chicory, burnet and yarrow. It is strange how some people are frightened by that word "herbs" and regard their use as a first step downward to a sandal-footed life eked out on locusts and wild honey. It somehow seems all right if you call the same plants "weeds" instead. But whatever you call them, the facts remain that grazing animals like them; that Robert Elliott, who rediscovered the ley farming system, strongly recommended them; and that no less a person than Sir George Stapledon admitted that we had been paying far too little attention to them in putting down our leys. Mr. Turner, like Sir George, stresses not only their value to the grazing animal but their contribution to the soil in warming it and releasing minerals from its lower strata.

There is some very practical advice in this book on making and feeding silage. It includes a plan for siting a silage clamp, where possible, in the middle of a field where fertility needs raising, and letting the cows help themselves from it. Not only would labour in cutting and carting be saved, but the cows, Mr. Turner says, would radiate fertility round the clamp. He has tried it and I have not, but I should rather have expected fertility to be concentrated on too small an area round the clamp to be of great practical value.

Fertility Pastures comes at a time when more and more of us are wondering whether we cannot produce milk more profitably by growing and using better grass and less concentrates, even if resultant yields break no records. More of us, too, are becoming dubious about the ultimate benefits of "steaming up" with lavish supplies of protein before calving, and it is not only farmers of "the organic school" who have begun to doubt the much publicized results of dosing grass with nitrogen.

It is interesting to observe how successful practising of his beliefs has given Mr. Newman Turner confidence. He no longer writes dogmatically to make people angry: he writes to make them think. It is a great improvement.

L.F.E.

Report of the Work of the British Council, 1934-1955. British Council. 2*s*. 6*d*.

If anyone doubts the value of the type of cultural propaganda with which the British Council interests itself (and it must be admitted that the ordinary Briton is inclined to be reticent about his own virtues), I would advise him to peruse this twenty-first birthday report of the Council. As befits the occasion, more than half the report is given to an account, largely from the hand of Sir Harold Nicolson, of the Council's development. He is supported by Sir Philip Morris, who contributes an appreciation of the work of Sir Ronald Adam, and by Sir Paul Sinker, who reviews the British Council as it is today. Then follows a good deal of interesting statistical information on such subjects as expenditure, welfare work, and visitors to the United Kingdom over the years.

The second part of the book comprises the report for 1954-55. During this year, the Council's services were again stretched to the limit. For example, nearly 4,000 visitors came to this country under the auspices of the Council, 82,000 books were sent out to 90 libraries, 160 university awards were made to British, Commonwealth and foreign teachers and research workers, and a large number of successful lecture, opera, ballet, drama and musical tours were organized. And these cover but a small fraction of the work which, last year, was achieved at a total cost to the Government of just over £2¼ million.

Perhaps the most significant development in the year was the setting up of the Soviet Relations Committee to encourage the exchange of visits in many fields, including agriculture and veterinary science, which have been taken up with enthusiasm.

Copies of the Report may be obtained from the British Council, 65 Davies Street, London, W.1.

L.W.T.

Life of the Spider. JOHN CROMPTON. Collins (Fontana Books). 2*s*.

Like little Miss Muffet, most people have an ineradicable aversion to spiders. Taxed with it, they can offer no logical reason, but frequently there is more than a trace of superstition and ignorance underlying what might almost be a fear. With the possible exception of the so-called " money-spider " which, as an augury of imminent financial advantage, enjoys a certain amount of tolerance, man's attitude to spiders of all kinds is one of remorseless aggression. If we knew more about them, their life, habits and place in the scheme of things, we might acquire a less illogical point of view than that which impels us to destroy what we do not understand.

For this reason, if for no other, Mr. Crompton's book is very welcome. He shows that spiders are of incalculable value as the most powerful allies which man has in his constant war against the teeming millions of insects which are opposed to him and his endeavours. Indeed, Mr. Crompton goes so far as to say that " the startling possibility exists that we could not live without them ".

What the average, non-technical reader of this book will appreciate more than anything else is the clear, entertaining way in which the author presents his subject; and with that entertainment he conveys a great deal of knowledge. He directs our attention to the gossamer engineering of the web-weavers, like *Aranea* and *Agalena*, whose snares are laid for the unwary with a consummate skill born of the inherited experience of countless generations. Quite another kind of snare is laid by the trap-door spiders, whilst the wolf spiders, jumping spiders and crab spiders hunt their prey rather than rely altogether upon fortuitous circumstances. Among the wolf spiders are those which have taken to the water, running over its surface film with the same ease as they do on dry land. Then there is the " raft spider " which hunts from its own home-made " boat ".

Mr. Crompton has much to say and describe about the innumerable species which populate the earth, both in temperate and equatorial climates, and describes their life and " loves " from his own observation and that of other arachnologists who, by monumental patience and tireless experiment, have gradually built up enthralling dossiers of the spider species.

The ant has, by biblical allusion, captured the prize for industry and wisdom, but, after reading this excellent book, I am not sure that the sluggard should not have been directed to the spider instead.

S.R.O'H.

Methods of Surveying and Measuring Vegetation. (Bulletin No. 42, Commonwealth Bureau of Pastures and Field Crops.) DOROTHY BROWN. Commonwealth Agricultural Bureaux. 35*s*.

Miss Brown's book is a valuable addition to the literature available to grassland research workers. It deals with the subject in four major divisions—sampling, botanical analysis, production, and utilization—and is well illustrated with photographs and line drawings. There is also a comprehensive bibliography and an adequate subject index, while a useful short chapter on the theory of sampling (contributed by Dr. G. M. Jolly) adds value. Both the subject-matter and the illustrations draw examples from a world-wide variety of vegetation types used for forage purposes. Emphasis has been placed not only on methods of sampling vegetation but also on measuring productivity and assessing grazing output.

The book should have a wide appeal to all who are concerned with problems of animal production. The ecologist and pasture agronomist who are interested in techniques for pasture research and are continually developing and modifying them, will find the review a most useful reference. To the student entering such a field of research, the wide and detailed treatment of the subject will be invaluable.

Attention is drawn to the crucial question of the relationship between herbage yields and animal production. The difficulty of relating these values, both subject to a range of errors from a variety of sources, constitutes the central problem of measuring utilization. The aim of improved methods of grassland management is to increase the proportion of herbage consumed, but there are a host of practical problems connected with both animal and pasture which reduce the chances of full utilization, and good techniques of estimation are essential if we are to detect where the important deficiencies in management occur.

As progress is made, the problems are viewed from a new angle and new methods are developed. In areas where progress is slower the original techniques have still much to offer. The author of this book has reviewed and discussed admirably the whole range of techniques that the research worker has used and is using.

D.W.C.

BOOK REVIEWS

Making the Farm Pay. G. B. CLARKE. Department of Agriculture, University of Leeds.

Looking over the neighbour's hedge to compare one's own results with his has always been an axiom of good farming. Nowadays, however, there is no need for a physical inspection of other farmers' crops and livestock. The same results can be obtained simply by comparing one's own farm accounts and financial results with local "standards" derived from the accounts of many other farmers.

This useful bulletin describes how simple farm accounts can be used to judge the relative success of a farm business. Comparisons of yields and output per 100 acres show whether a farmer's type of farming and technical knowledge are satisfactory. If these are adequate, attention can be concentrated on the inputs, or the costs side of the accounts. Each major item of costs should be examined in turn. For example, output per £100 labour, livestock output per feed acre, and pig output per £100 food each reveal whether a particular part of the farming programme is pulling its weight. In this way, any weaknesses in the organization of a farm can be detected. Having found the weaknesses, it is then possible to budget for alternative methods of improving the position. The author has not described this procedure; he has restricted the scope of the bulletin to the initial diagnosis, which is essential before any economic remedy can be prescribed.

The description of the method of diagnosis is simplified by working out an example at each stage. With these examples to guide them, most farmers and farm advisers should be in a position to undertake a fairly simple economic analysis of a farm business, using for comparison the standards available from the local N.A.A.S. District Advisory Officer.

A copy of the bulletin can be obtained free from the Agricultural Economics Section, Department of Agriculture, The University, Leeds, 2.

K.D.

A History of the Institute of Brewing. W. H. BIRD. The Institute of Brewing, London. 42*s*.

Towards the end of the nineteenth century a small group of brewers and brewing pupils met periodically to discuss problems connected with their industry; they formed the Laboratory Club in 1886, and Mr. Bird traces the growth of the Institute of Brewing from this small beginning to the pre-eminent position which it now occupies in the brewing world.

From its earliest years the Institute has largely been concerned with education, training and research. The story is well told of how much has been successfully accomplished by wise direction and collaboration with other bodies, leading to the institution of its own qualification, the Diploma of the Institute of Brewing, and, in the case of research, eventually to the establishment of the Brewing Industry Research Foundation.

Brewing is closely allied to agriculture: it is a biological industry and its raw materials are mainly agricultural products. It is fitting that the Institute's generosity and services to barley and hop growers, through its Research Scheme, should be recorded, as well as the good relations which have been fostered by meetings and conferences of brewers and growers arranged by the Institute. Reference is also made to the war-time work of the Institute on brewers' grains and yeast as stockfood.

The book contains lists of officers and their periods of office and a description of the armorial bearings of the Institute, which appear in gold on the front cover of this publication. The illustrations include forty-seven portraits of prominent personalities connected with the Institute.

Mr. Bird has performed a significant service to brewing and the allied industries in writing this history. He occupied the posts of Assistant Secretary or Secretary of the Institute from 1908 to 1951 and, as Sir Sydney Nevile says in the foreword, "Nobody could have been better qualified to write this history than one who had played a central part in it for so long. . . ."

The book is well produced and the subject-matter happily arranged; its division into five sections, each dealing with a definite stage in development, makes for easy understanding. It provides an excellent example of how an industry can raise its status by the co-operative efforts of its members, and it can be recommended to all who take an interest in the co-ordination of education and science with industry.

A.H.B.

BOOK REVIEWS

Broilers, Their Production and Management. ERIC F. GOLDEN. Poultry World. 4*s.* 6*d.*

To the inexperienced, the production of broilers may seem to be an easy method of raising table chicken, and this timely publication will do much to dispel such over-optimism. Any poultry-keeper contemplating turning over to table poultry, and indeed many who are already engaged in this branch of the industry, will profit by reading the booklet.

The author is himself a producer and therefore deals with his subject in a practical manner. He starts with a brief account of his visit to America to study methods of production there, and this is followed by an outline of the conditions which must be observed if similar methods are to succeed in our own country.

Useful information is given on housing and attention is rightly drawn to the limitations in the use of existing buildings. The plan of the house which is widely used for broiler production would have been clearer to the layman if a cut-away, isometric projection had also been used to show the building and equipment. Otherwise the subject is well covered. Floor and cage methods of rearing are also discussed, and the chapters on equipment and management should prove most helpful.

It is obvious to all interested in broilers that we have a long way to go before we get the right type of bird. A few ounces per bird makes a tremendous difference in the total weight on a large number, and it would be interesting to have some information on the relative weights of light-heavy crosses and heavy crosses at the usual selling age. It is also a pity that the need for keeping records has not been stressed by the author, for in broiler production a small margin can result in a considerable profit or a heavy loss. The provision of a specimen chart showing food consumption, growth rate and mortality would have done much to emphasize the vital importance of day-to-day records. Marketing is another important factor, and Mr. Golden is to be congratulated here on the sound advice which he gives. Good reasons could, in fact, be advanced for reading this chapter before any other.

G.E.B.

Know Your Tractor. Shell Petroleum Co. Ltd.

Shell have produced a truly magnificent book of 350 pages, indexed and well illustrated with photographs and coloured drawings, which covers every conceivable aspect of the tractor, its operation and its maintenance. It has the merits of simplicity, clear exposition and a practical approach, and thus, in the right hands, will assuredly promote that knowledge which the farmer must have if the tractor is at all times to be a reliable servant. Tractors, like horses before them, can at times be singularly intractable! This book is the answer.

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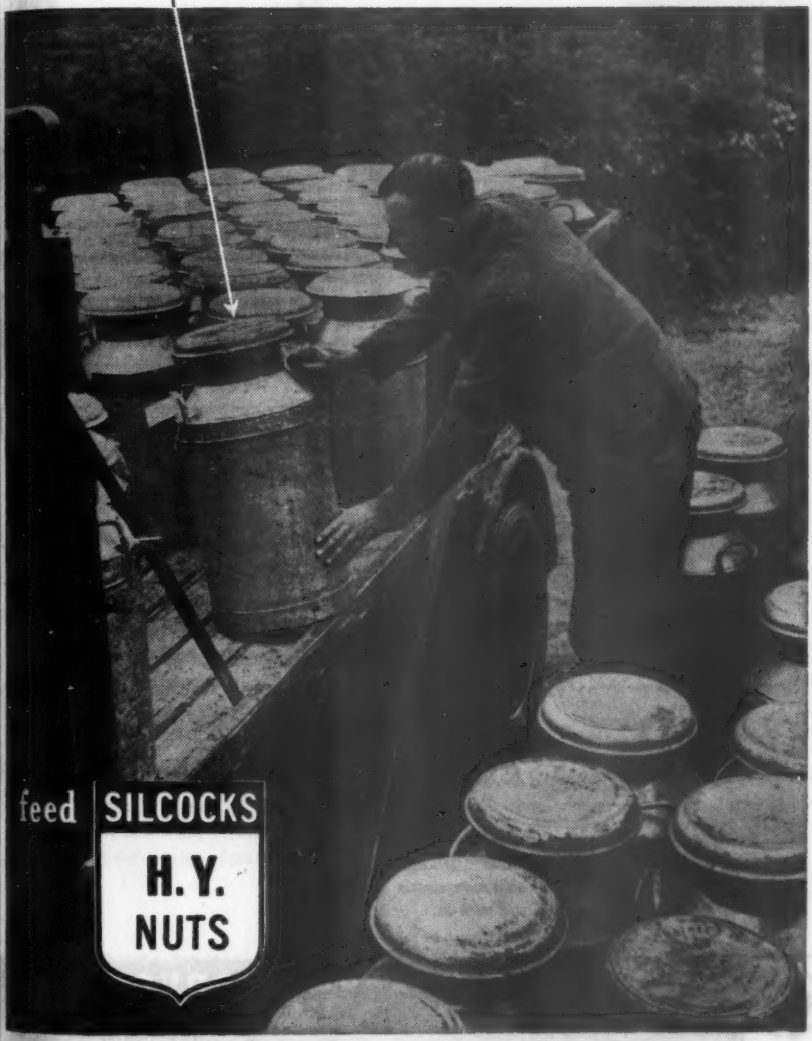

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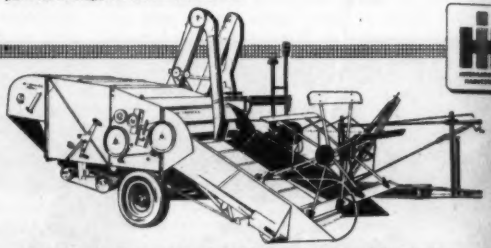

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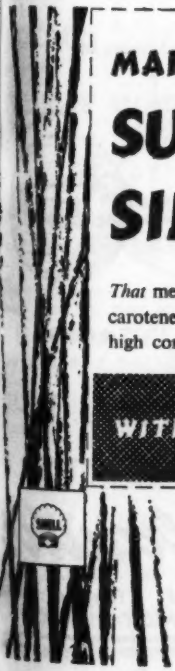

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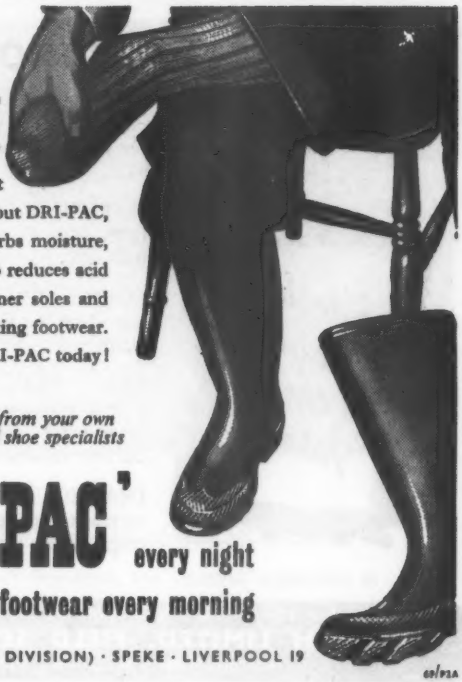

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The frequent **occurrence of potash deficient soils indicates that in many areas more potash is being removed by crops than is replaced by potash dressings.**

POTASH is taken up freely by crops and goes off the farm in large amounts in grain, potatoes, sugar-beet, milk, etc.

MOREOVER, a large proportion of the potash retained on the farm is lost by drainage from the manure heap.

THE TOTAL potash required for average crops in a 4 or 5 course rotation amounts to about 5 cwt. per acre Muriate of Potash (60%). The modern higher-productive varieties require more potash.

INADEQUATE replacement of potash removed means increasing potash deficiency reflected by less robust crops, lower yields and poorer quality.

For advice and information on the use of potash apply to:-

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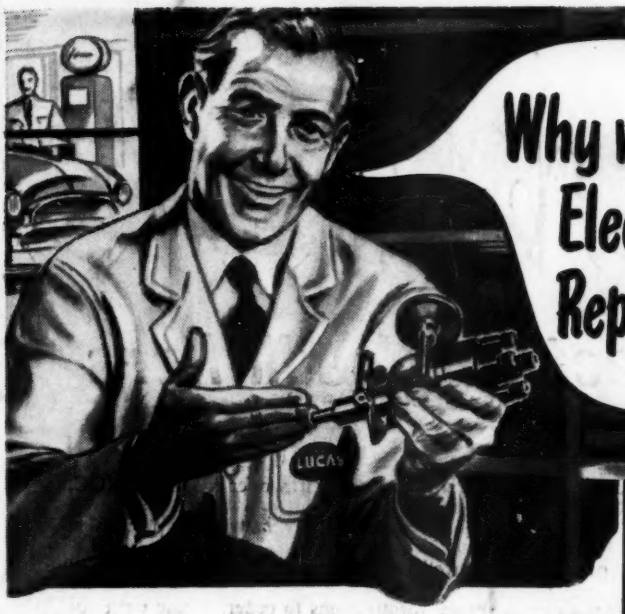

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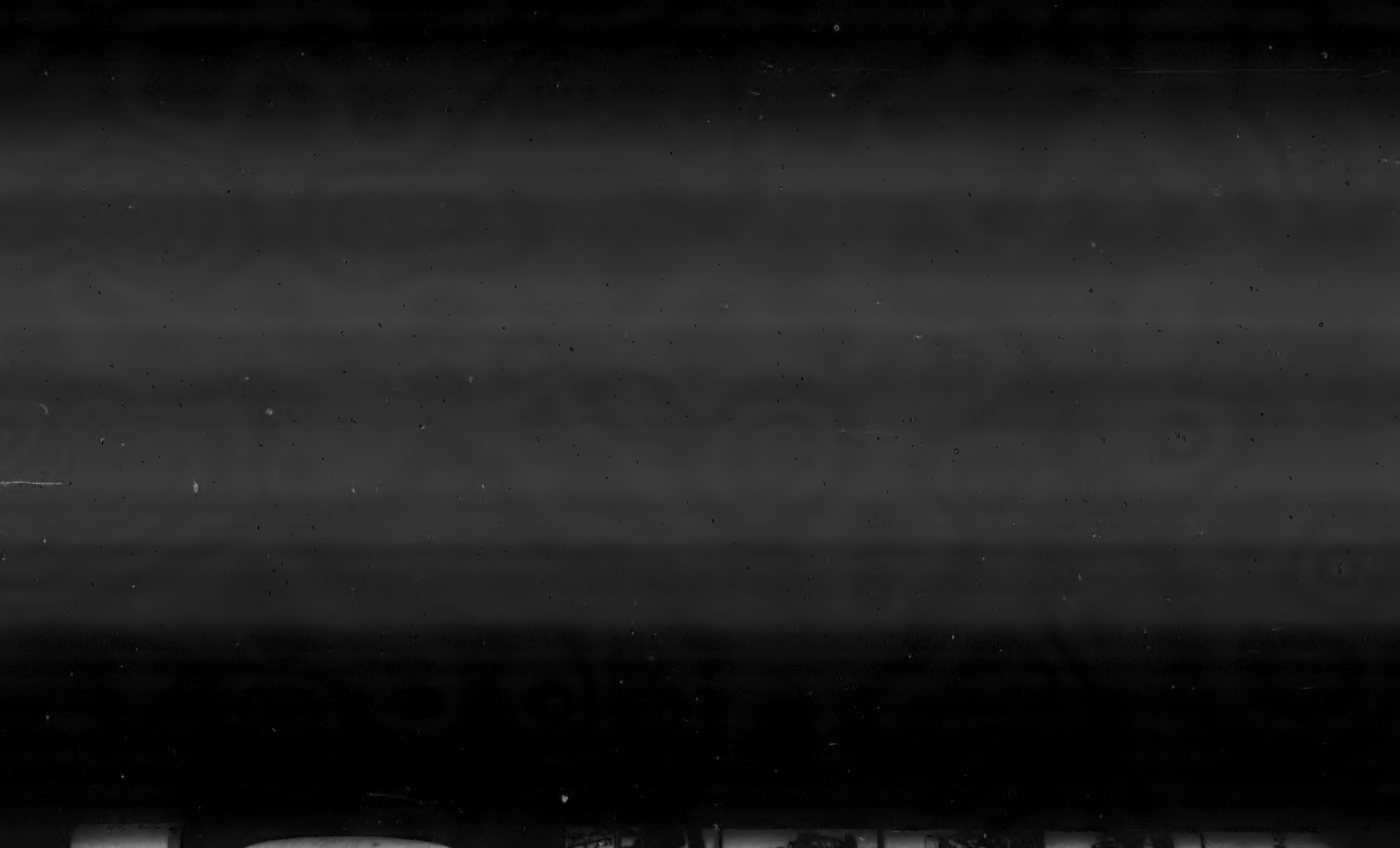
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